

JULY 1984

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ELECTRONICS TODAY INTERNATIONAL

Australia's Advanced Technology Telescope

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Dick Smith catalogue
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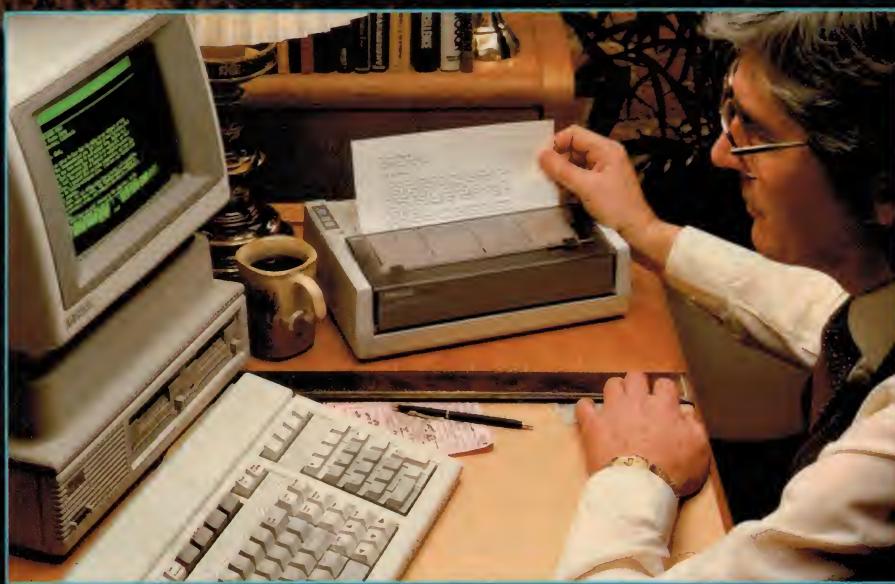
Printers — choosing & using

Robots & the future of work

Build:

**Paging amp
system**

**25 watt UHF
booster amp**



New Commodore Column!

IT'S BEEN WORTH WAITING FOR.



Pioneer's extraordinary second generation Compact Disc Player is here.

Time flies. Only 18 months ago, the hi-fi world was stunned by Pioneer's Compact Audio Disc player. Its laser and digital technologies introduced near-perfect stereo sound reproduction. "How will they top that?", they asked.

With the extraordinary new PD-70, Pioneer's second generation Compact Disc player.

We started by making the compact disc player more compact. The PD-70 loads horizontally (not to mention automatically), making system mounting much more practical.

The PD-70 is also an incredibly stable compact disc player. Comprehensive internal damping and robust construction means the PD-70 won't "skate" during operation.

The PD-70 is more intelligent too. Its memory can be programmed to repeat tracks up to 10 times and that programme can be interrupted or amended at any time.

The PD-70's 16-bit Digital Binary Display is the most sensitive and versatile metering system yet devised.

It breaks signal values down into 6dB increments - and switches to a "peak metering" mode at the touch of a button.

And, because all of the displayed information is both sourced and expressed digitally, the PD-70 can claim to have the most accurate metering display system available.

The PD-70's specifications speak for themselves: Dynamic range has been improved to 95dB. Signal-to-noise ratio has been improved to 95dB. T.H.D. is down to 0.004%, 1kHz.

Compact Disc has taken the next step. Pioneer's new PD-70 gives you music that is virtually distortion free, and laser technology means that your music need never deteriorate.

Pioneer's PD-70 means simply better stereo sound; a step closer to musical perfection.

In our opinion, that's always worth waiting for.

 **PIONEER**®

Leads the world in Sound and Vision.

PIO 0364

QUICK INDEX



WHEN GOVERNMENTS proceed with hasty or ill-advised decisions, the community pays in many ways for many years. The 1950s Huxley Committee's decisions on television channel allocations is a case in point. We're still paying, some twenty years later, for the reshuffle in channels that took place in the early 1960s to correct problems that arose with the initial channel frequency recommendations.

Allocating TV channels in the 'international' FM broadcast band has been the main contention since day one. The Minister for Communications, Mr Michael Duffy, recently announced that channels 3, 4 and 5 are to receive new frequency allocations, clearing 'Band II' for the expansion of FM broadcasting services. Main stations required to move from Ch. 3, 4 or 5 are to be allocated alternative VHF channels, or where this is not possible, they would move to UHF (as would some translators).

The Government has also agreed to the *eventual* transfer of Ch 5A stations to other channels. This allocation has long been a thorn in the side of non-broadcast services such as defence, weather and scientific satellites and radio amateurs. To move 5A involves moving distance measuring equipment (DME) to the internationally used UHF band, creating room for two new VHF TV channels — 9A and 12. A Task Force is to be set up within the Department of Communications to oversee the moves. A timetable for all the clearances and transfers is to be announced later this year.

What was it the Pope said to Michaelangelo as he laboured long over the Sistine Chapel decorations? "When will you make an end?"

A CHANGE OF FACE

From next month, our cover will look distinctly (and, we hope, distinctively) different. Turn to page 13 this issue for a preview.

Roger Harrison
EDITOR

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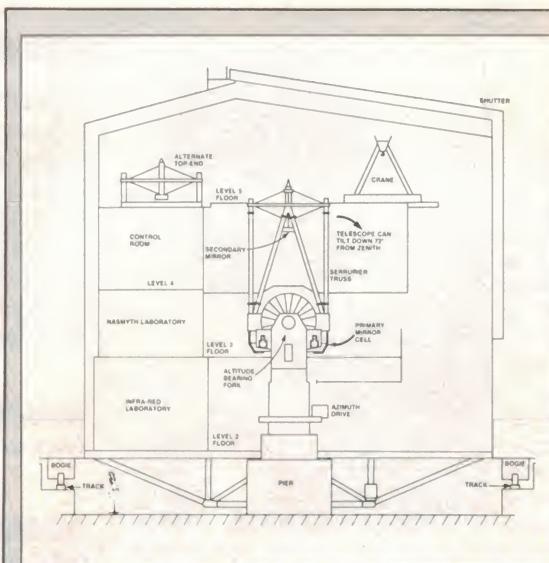
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Australia's Advanced Technology Telescope

Cover. Photograph courtesy Mount Stromlo and Siding Spring Observatory. Design by Ali White.



Printers — types, technologies — grand survey



Paging amp/sound system to build

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This page is to assist readers in the continual search for components, kits, printed circuit boards and other parts for ETI projects and circuits. If you are looking for a particular item or project and it is not mentioned here, check with our advertisers.

MINI-MART 160

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State-of-the-art design and instrumentation at Siding Spring Observatory.

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The syntax and semantics of a new language for computing

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A four-input, 150 watt output sound system for clubs, halls etc.

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Continuation of last month's feature project — construction.

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A low-cost booster for UHF mobile rigs.

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Top-of-the-range sound and facilities from Aiwa.

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Ritron monitor review

A look at a new, low-cost green/amber monitor.

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NEXT MONTH



ELECTRONIC MOUSE TRAP
"Mouse plague!", shouted the newspaper headlines, as if it was something you didn't know already. The breaking of the drought and the abundance of natural feed has brought on a genuine plague — city and country. Tried to buy a mouse trap lately? On the tenet that 'build a better mousetrap and the world will beat a path to your door', Ian Thomas has devised an electronic mouse trap that despatches the beasts

swiftly and perhaps a little more humanely than other methods.

STEREO TV REVIEW

The introduction of stereo TV means a subtle, yet far-reaching, change in direction for this standard piece of lounge furniture. Five stations have, so far, broken the ground and more will introduce it within a year. We will tell you how the system works.

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Will your



Studying a degree course doesn't automatically lead to professional employment. Except with the Royal Australian Air Force. You can undertake a Science degree while securing a future. If you have matriculated or are currently undertaking your matriculation, are an Australian citizen or eligible to apply for Australian citizenship, are under 20 on the 1st February of your intended year of entry and are able to meet our selection requirements you will be offered a career that will lead you to becoming an Officer and a Pilot. Studying at the RAAF Academy as well as the new Australian Defence Force Academy.

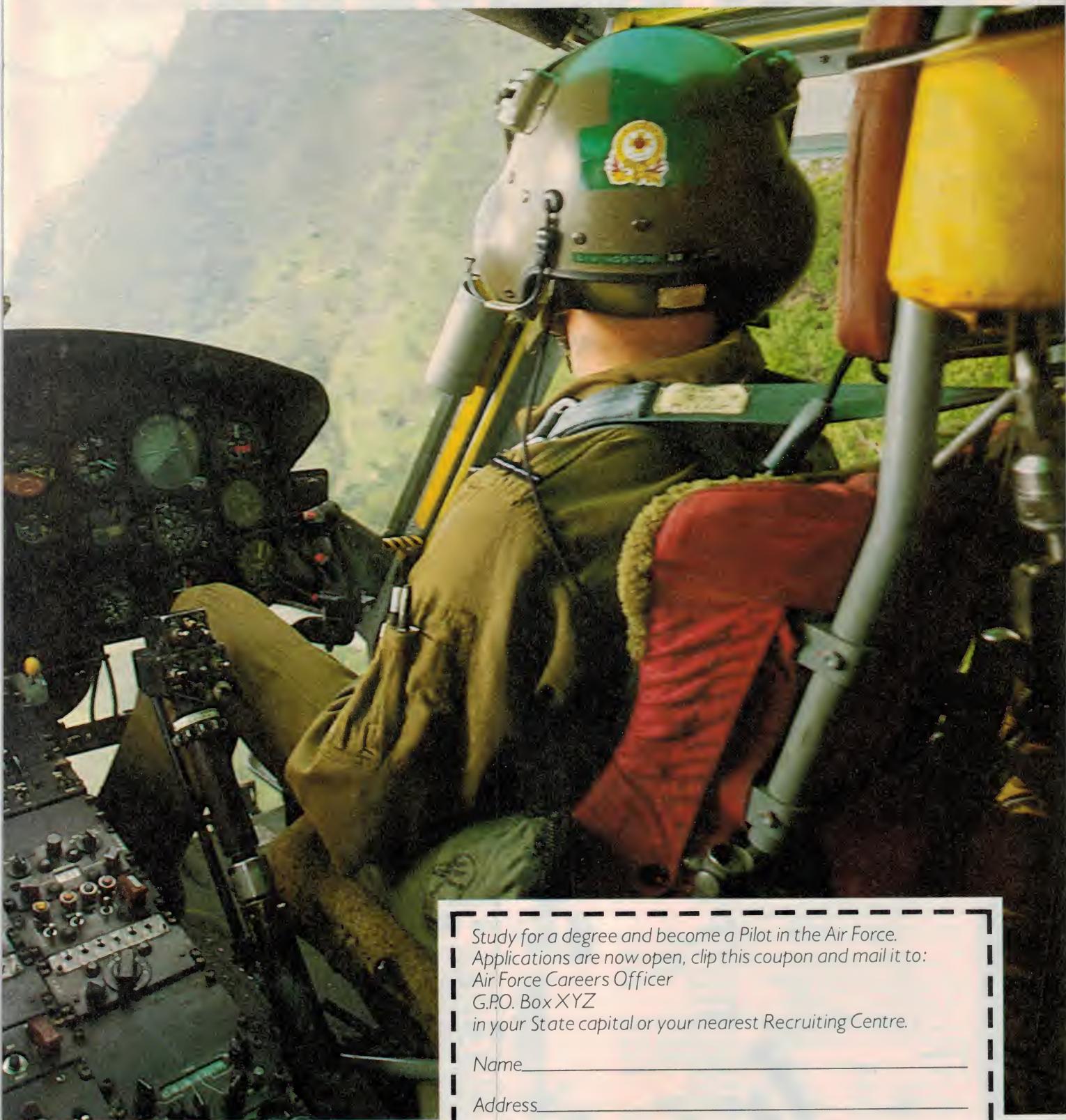
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only \$249⁰⁰

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The fully assembled and tested version can be legally plugged into any phone socket to replace your standard phone. It comes complete with a telephone hardwired into the modem.

only \$329⁰⁰

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Specifications:

Data CCITT V.21 & V.23, Bell
Standards 103 & 202
Data Rates 300, 600 and 1200BPS
Backward Channel 75 PBS in conjunction with 1200 BPS
Computer Interface CCITT V.24 (RS232C)

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240VAC/3W
Front Panel Controls Mode switch (12 position rotary), Connect Switch (3 position toggle), Tests Switch (3 position toggle).

Front Panel Indications Connect LED, Data Carrier Detect, Received Data, Request to send, Clear to send, Transmit Data, Ring Detect, Test switch off normal, POWER.

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only 75¢

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only 85¢

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\$1⁰⁰ for 25!!

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Back in Stock
by Pub
Demand

Perfect to drive your automated helper around.

Nominally 24 volt, but runs perfectly on 12VDC. These motors put out incredible torque - try and stall one!!

- ★ Output speed at 12V no load approx 100mA
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- ★ Size overall 55mm long by 35mm wide
- ★ Shaft length 20mm
- ★ Shaft diameter 4mm

These superb motors are made by Canon. We are selling them at approximately 30% of the normal price.

\$9⁹⁹ each

\$31⁰⁰

for 4.



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Replacing the standard 'Cannon' connectors, Neutrik connectors offer a higher standard of performance together with a number of revolutionary features, making them right choice where you need the ultimate in reliability and ease of use.

A revolutionary collet type cable grip provides a reliable grip on both thick and thin cables and a touch lock device allows you to quickly and easily remove and insert the cables. Construction is to the highest standard - made in Switzerland!!

Prices:

3 pin 1.9

Line Male 3.50

Line Female 3.50

Chassis Male 3.20

Chassis 3.50

Female

Chassis Male 2.50

non locking

2.50

Chassis Female non locking

Line Male 4.95
right angle
Line Female 4.95
right angle

4 pin

Line Male 4.50
Line Female 5.50
Chassis Male 3.50
Chassis 3.50
Female

5 pin

Line Male 6.50
Line Female 7.50
Chassis Male 5.50
Chassis 5.50
Female

6 pin

Line Male 8.95
Line Female 10.95
Chassis Male 7.50
Chassis 7.50
Female

Mains Type

Line Male 6.50
Line Female 6.50
Chassis Male 6.50
Chassis 6.50
Female

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Others are selling these black anodized aluminium heatsinks for 95¢ each! Look at our tiny price:

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Size: 106(H) x 67 x 67mm

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2661-3 USARTS
going for a song
only \$14⁹⁵

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Spade terminals. Weight 4.06lbs.

Maximum discharge 60A.

Terminals may be used as solder lugs.

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10 up (any mix)
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DE9 Backshell 1 piece	2.00	1.80
DE9 Backshell 2 piece	2.95	2.50
DA15P Male 15 pin	2.95	2.50
DA15S Female 15 pin	3.50	3.00
DA15 Backshell 1 piece	2.00	1.80
DA15 Backshell 2 piece	2.95	2.50
DB25P Male 25 way	4.50	3.95
DB25S Female 25 way	4.95	4.30
DB25 Backshell 1 piece	2.00	1.80
DB25 Backshell 2 piece	2.95	2.50

20%
OFF
THESE
PRICES!

	1-9	10up
Male 9 pin PCB Mnt	3.25	3.10
Female 9 pin PCB Mnt	3.95	3.75
Male 15 pin PCB Mnt	3.95	3.75
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Female 25 pin PCB Mnt	5.50	5.00

10%
OFF
THESE
PRICES!

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Avtek have really cornered the market on these connectors. IDC (Insulation Displacement Connectors) are the best, quickest and most reliable way to connect electronic equipment. We have a huge range of IDC connectors and matching cable, all ready for immediate delivery!!!

IDC Connectors P.C. Mount Headers

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16 pin Straight Header	4.75	4.50
20 pin Straight Header	5.50	5.00
26 pin Straight Header	6.75	6.00
34 pin Straight Header	7.75	7.00
40 pin Straight Header	8.75	8.00
50 pin Straight Header	9.75	9.00

	1-9	10up
10 pin Right Angle Header	3.75	3.50
16 pin Right Angle Header	4.75	4.50
20 pin Right Angle Header	5.50	5.00
26 pin Right Angle Header	6.75	6.00
34 pin Right Angle Header	7.75	7.00
40 pin Right Angle Header	8.75	8.00
50 pin Right Angle Header	9.75	9.00

Wire Wrap Headers

	1-9	10up
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50 Pin Right Angle	12.95	11.95



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16 pin Card Edge Connector	8.50	7.95
20 pin Card Edge Connector	8.50	7.95
26 pin Card Edge Connector	8.95	8.50
34 pin Card Edge Connector	7.95	7.50
40 pin Card Edge Connector	11.50	11.00
50 pin Card Edge Connector	12.00	11.50

Female Socket Transition Connectors IDC Type

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10 pin socket	4.50	4.00
14 pin socket	5.00	4.50
18 pin socket	5.25	4.50
20 pin socket	5.50	5.00
24 pin socket	6.00	5.50
26 pin socket	6.50	6.00
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Colour

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10 way	\$1.25	25 way
16 way	\$1.75	34 way
26 way	\$2.50	
34 way	\$3.45	
50 way	\$5.25	
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Book Bargains

Motorola M6800 Programming Reference Manual

Includes description of M6800 Program visible registers, Interrupts and Stack operations, Address Modes, Instruction set, Commands for EXbug, MIKbug, MINIbug II, MINIbug III. Also has descriptions of MPU, ROM, RAM, PIA and ACIA. Normally selling for \$9.95

only \$3.95

Motorola Linear Interfacing Manual

Includes full technical details of the huge range of Linear ICs including: Memory/Microprocessor Support, Driver Receivers, Communication Interface, Voltage Comparators, Data Conversion, Voltage References. Cross referenced with package information and applications notes. A must for every professional or hobbyist. Normally selling for \$11.95. This month:

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now only \$4.95

PASCAL with Style

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BASIC with Style

Intended for BASIC programmers who want to write carefully constructed, readable programmes. Rules for writing more accurate, error free programs. An excellent guide to program design and efficiency. Normally selling for 14.95

only \$4.95

Using Microcomputers in Business

Written by a consultant to owners of small businesses this book is essential reading for any purchaser of microcomputer systems or software. Normally \$14.95

now only \$4.95

Australian academic wins Royal Society medal



Professor Ward receives his award. The Hughes medal was presented to Prof. Ward (left) by the British Consul-General in Sydney, Mr M. S. Berthoud.

The 1983 Hughes Medal of the Royal Society has been awarded to Professor John C. Ward of Macquarie University. The honour is regarded as second only to the Nobel Prize.

Japanese satellite in trouble

Technical failures discovered in what would have been Japan's first operating broadcast satellite have cast a shadow on Japan's ambitious plans for satellite development for information networks.

Satellite operators have detected a malfunction in a transponder on the *Yuri IIa* broadcast satellite, launched by the National Space Development Agency (NASDA) in January.

It was the second of three transponders to fail, following another breakdown on March 23. The cause of the problems hasn't been established. The satellite was assembled and launched by NASDA, using transponders that came in a sealed 'black box' from General Electric Corp. of the US. The transponders use special tubes

manufactured by the French company Thomson-CSF.

Toshiba Corp. was the main Japanese contractor for the satellite, which included 70 per cent foreign-made and 30 per cent domestic-made parts. Officials of both the government-owned Japan broadcasting corporation and NASDA maintain that the malfunctions aren't permanent breakdowns and there's still hope for repairs.

However, the local media reported Tuesday that repair to the devices would be difficult and the problems could affect scheduled experiments on high-grade image broadcasting and advanced facsimile broadcasting that were to use the *Yuri IIa*.

In addition, the failure of the *Yuri IIa* may affect plans to develop communications satellites domestically.

The Royal Society was founded in the Middle Ages to advance the physical sciences. All the most famous British scientists have been members, including Newton, Boyle, Compton and Ryle. The voyages of discovery that finally uncovered Australia were undertaken at the instigation of the society.

Professor Ward is only the

third Australian (after Sir Mark Oliphant and John Pawsey) to receive the Hughes Medal. It was awarded for his 'distinguished and influential contributions to Field Theory, particularly to quantum electrodynamics and the Salem-Ward theory of weak interaction'.

The work ranks in importance with Maxwell's theory of electromagnetism and the quantum theory due to Einstein, Bohr, Heisenberg and others in explaining the fundamental properties of matter.

Established by the Royal Society in 1902, the Hughes Medal is awarded annually for original discovery in the physical sciences, particularly electricity and magnetism, or their applications.

Professor Ward was born in 1924. He has worked at Princeton and John Hopkins Universities in the US. Since 1966 he has been Professor of Physics at Macquarie University.

He has contributed much to physics, including work on particle theory, statistical mechanics, solid state physics and biology.

He was elected to the Royal Society in 1965 and has received recognition by the Institute of Physics and the American Physical Society.

Previous recipients of the Hughes Medal include A. H. Compton, Enrico Fermi, Max Born, Sir Harrie Massey, Viscount Cherwell, Freeman Dyson and Sir Martin Ryle. Many recipients have also become Nobel Laureates.

How-to videos

Educational Video Productions of Melbourne has produced and are distributing a series of educational videos covering electronic techniques.

The videos were designed with the assistance of TAFE and leading Australian electronic companies to meet the need for step-by-step instructional programs. They show in simple terms the procedure of taking a circuit idea from a schematic through to the finished stage, including the crucial process of soldering.

There were created with the

recently introduced TAFE 'basic electronics certificate' in mind.

The tapes vary in running time but the average is 22 minutes long. Professional studio facilities, presenters, directors and writers were involved throughout to achieve professional broadcast quality material.

The tapes are \$39.95 each (tax exempt) or \$43.53 each (tax inclusive). For further information contact Educational Video Productions, 57 Burwood Rd, Hawthorn Vic 3122. (03)819-4983.

Space antenna

Part of a huge, orbiting space antenna that could usher in the age of worldwide communication using simple hand-held radios has been built by engineers in California.

The full antenna, when deployed in space, would be so powerful that it could pick up weak signals from Earth and rebroadcast them at much higher amplification to other parts of the globe. Small battery-powered transmitters and receivers are all that people would need. It may even be possible to communicate with radios small enough to be

strapped onto someone's wrist. So far engineers have built four 'ribs' of an antenna that could be wound inside a central drum, carried into orbit by the space shuttle, and then unfurled in space.

The system would be part of a 55 metre diameter antenna. Forty eight ribs, made of graphite epoxy and weighing about 9 kg each, would be needed to support a gossamer thin web of gold-plated molybdenum wire which would act as the reflecting surface. Gold is applied to the molybdenum yarn in a layer only about a dozen atoms thick.

private inventors, academic institutions, government agencies and major companies.

This will be one of the first exhibitions of this type in Britain, and the Australian government is keen to introduce Australian technology to the British.

Firms or individuals with technology suitable for this type of expo should contact Brian Usback at the Department of Trade on (062)72-2513.

Hi-Tech expo

The Department of Trade is seeking advanced technology firms to participate in an exhibition in the UK in November '84.

The International Exposition for Technology Transfer is being sponsored by the British government and Control Data Corporation of the USA.

The exhibition will be open to

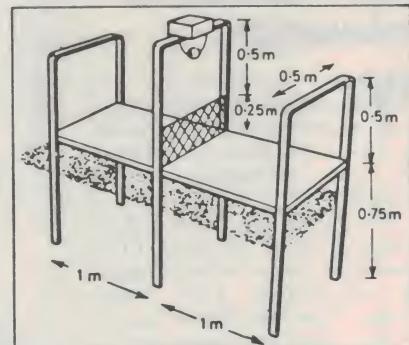
WAIT for robots



An ASEA robot arm has now been installed in the Electrical and Electronic Engineering Department of the Western Australian Institute of Technology. This industrial robot from Sweden was sold to WAIT at a special discount for education.

It is already being used for three jobs for local industry; it is hoped that it will raise revenue as well as being a teaching tool.

The Electrical and Electronic Engineering Department is planning to establish a significant Robotics Centre within 12 months. Postgraduate courses in Electronic Engineering already include units in robotics which cover industrial robots, safety and fail-safe measures, and artificial intelligence in robots. These units are popular with paying extension students from industry.



Robot Olympics?

Personal robots from the United States and Britain will compete against each other in a ping-pong match. The competition, which will take place in 1985 will be held at the Computer Fair exhibition in London. It is the brainchild of Dr John Billingsly from Portsmouth Polytechnic.

The main challenge of this sporting tussle, which will engage some of the best brains of the countries' scientists and engineers, will be to develop cheap sensors to enable the robot to 'see' and return the ball to its opponent.

Billingsly said, "In the first year I only expect the robots to

return the ball once. In the second year the robots should be playing rallies, and in the third year they will be playing positional shots."

The contest organisers are expecting to see robots built by enterprising individuals rather than large manufacturers. They also warn potential entrants to rid themselves of preconceived ideas about bat shape.

The table will be 0.5 m wide with a frame at each end which limits the playing area. A mechanism over the centre frame will serve the ball toward the serving robot which then returns the ball so that it bounces once in its opponent's side of the court.

Chip troubles

How much longer will chips go on getting better? Today's microelectronic circuits already crowd a half-million transistors on a piece of metal no larger than a fingernail, and it will soon be possible to build chips that contain a million or more transistors. But as the number of transistors on a chip rises, so does the difficulty of finding a market large enough to justify the cost of building the circuit.

Perhaps more important, the time required to design the chip also increases, so that the market could be gone before the chip is ready. In fact, designing a new integrated circuit other than a microprocessor or a memory is today more of a feat than manufacturing it.

Computer programs, however, are coming to the rescue. The latest class of programs, called silicon compilers, enables designers to specify what a circuit should do and, in a general

way, how it should be done. The computer takes it from there.

As yet, there are few silicon compilers. The programs can design only a limited variety of chips at present. And some large makers of integrated circuits are sceptical.

To reduce design time, new types of integrated circuits — called gate arrays and standard cells — have been developed. Both types offer the designer a choice of standard circuit elements that a computer automatically connects once the designer specifies what job the circuit is to perform. Silicon compilers go further, not only doing the wiring for the designer but also selecting the circuit elements on his behalf.

Although compilers are fast, one disadvantage is inefficiency. The programs aren't yet able to use the space on a chip as economically as the best human designers can do with only minimal help from a computer.

Bicentennial telescope

Work commenced in November '83 on the Australian Synthesis Telescope, and is due to be completed in time for the bicentennial celebrations.

The project involves the construction of six dishes at Culgoora and one at Siding Springs in mid-western New South Wales. These will then be linked to the existing telescopes at Parkes and possibly Tidbinbilla, to provide the very long base line of the synthesis telescope.

Project director is Dr R. H. Frater, whose previous experience with state-of-the-art radio telescopes includes the Fleurs synthesis telescope, near Sydney, which he worked on in the early seventies.

Large synthesis telescopes represent the next stage in the development of radio astronomy. They are a generation beyond the huge dishes, like the one at Parkes, that have dominated astronomy during the last thirty years.

The synthesis telescope will behave like a single dish 300 km across.

Results from the Australian Telescope will directly compliment the US Very Large Array telescope, a similar synthesis design. It is expected that both instruments will remain in the forefront of astronomical discovery well into the twenty-first century.



Polaroid videoprinters

The Polaroid VideoPrinter Model 4 — with its larger format companion the Model 8 — represents a major new direction for the company, best known for its pioneering role in instant photography.

The VideoPrinter Model 4 uses analog technology to record video images on Polaroid. The new system processes Polaroid positive transparency films in minutes, without a darkroom, chemical baths or strict temperature controls.

Both the Model 4 and Model 8

Videoprinters are self-contained peripherals which connect to a host system's analog video signal and can operate in parallel with a video monitor. They connect in minutes to most computer or video systems, without hardware or software modification.

The system delivers virtually distortion free, accurate colour copies superior in quality to images photographed directly from the screen and frequently better than the video image itself.

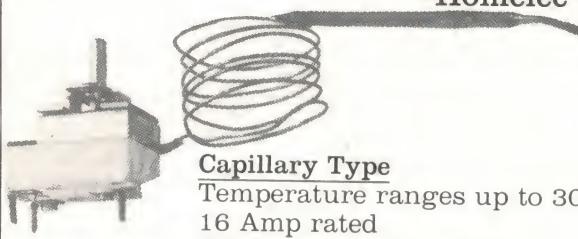
Automatic settings for bright-

ness, contrast and colour balance can be manually adjusted to achieve complete tonal control or dramatically modify the image. Other capabilities of the Model 8 include negative imaging, mirror reversal, the production of colour printers from black and white signals and black and white prints on colour film.

For more information contact Polaroid, 31 Waterloo Road, North Ryde NSW 2113. (02) 887-2333.

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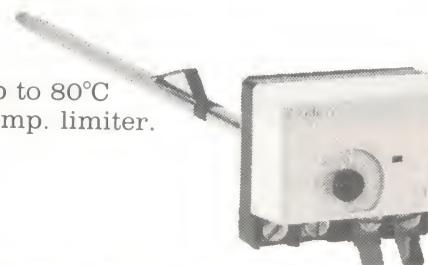


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ETI'S BOLD NEW LOOK

NEXT MONTH:

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When you see us on the news stands next month, we're going to be different! As part of our continuing plans to improve the magazine, August's front cover will have a bold new 'banner'.

Instead of the familiar banner you've seen for the last few years, here's the banner you'll see.

Great, isn't it! We believe that this new banner is more in keeping with our bigger, brighter and more dynamic image.

PLUS MORE FEATURES THAN EVER!

Consumer electronics

August's issue won't just have a prettier face, either. Inside you'll find a major feature on the Consumer Electronics Show in Perth, with a comprehensive coverage of the firms with stands — and their exciting new products.

Computing

For computing enthusiasts, we've got a feature explaining the ins and outs of the Unix operating system. Also an article on extending the BASIC of a low cost VZ-200 computer. PLUS all the regular columns . . .

Build-it-yourself projects

When it comes to projects, August features a new 150-watt Bass Guitar Amplifier design which features an inbuilt five-band graphic equaliser. There's also a new electronic mousetrap, to help with the current mouse plague (tried to buy a mousetrap lately?)

Audio

Compact disc player prices are dropping! We'll be looking at the new \$599 compact disc player from Yamaha. Interested in stereo TV? We'll be taking a look at how it works.

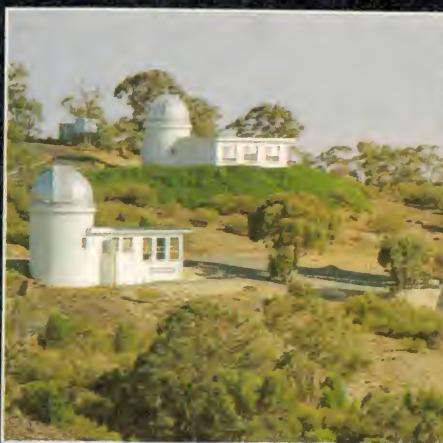
Shortwave radio

We haven't forgotten the keen shortwaver, either: there's an interesting story on the new proposals to broadcast on shortwaves direct from space satellites.

Australia's Advanced Technology Telescope

Roger Harrison

This wholly Australian designed and assembled optical telescope, built for the 'bargain basement' cost of about \$3.2 million, will offer astronomers one of the most advanced and efficient facilities for research and training available in the world; today and in the future.



Picasso's view. Like a cubist sculpture in a Martens Landscape, the cubicle building of the Advanced Technology Telescope contrasts with the familiar domes of the other ANU telescopes at Siding Spring.



MOUNT STROMLO & SIDING SPRING OBSERVATORIES

Mount Stromlo and Siding Spring Observatories (MSSSO), part of the Research School of Physical Sciences of the Australian National University (ANU), operate from two sites:

Mount Stromlo Observatory. Located on a site overlooking the national Capital, Canberra, this is the headquarters of the complex. It was

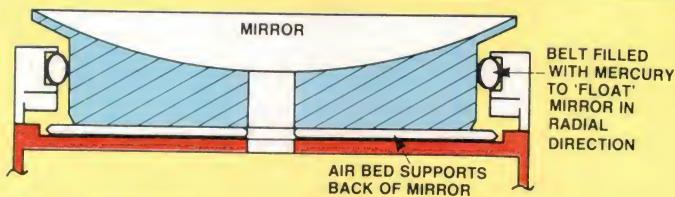


Figure 1. Mounting details of the primary mirror (scale exaggerated). An 'air bed' supports the rear of the mirror while a belt filled with mercury 'floats' it in the radial direction.

THE PRIME MINISTER, Mr Bob Hawke, A.C. M.P., inaugurated the Australian National University's 2.3 metre Advanced Technology Telescope on 16 May 1984, ushering in a new era for Australian astronomy and astronomers. At the ceremony, Mr Hawke said: "The ANU is to be congratulated for its initiative in developing this telescope which sets new international standards in astronomical engineering and is the most advanced optical telescope ever built.

"There are good reasons for Australians to be proud of this achievement.

"The design and development of the telescope is very much a co-operative Australian venture. Apart from several components which could not be manufactured in Australia, construction took place in the ANU's own workshops and involved a large

number of Australian engineering firms, supply and service companies and consultants.

"The astronomers, engineers and technicians at Mount Stromlo and Siding Spring Observatories, with the support of the ANU and co-operation of industry, have created a facility which clearly demonstrates Australia's capacity to contribute to the advancement of high technology.

"The telescope is a particular tribute to the entrepreneurship of Professor Mathewson, for it is he who sought out the elements from a variety of sources and has been responsible for their synthesis into an impressive piece of research equipment."

Why?

Four main factors led to the construction of the Advanced Technology Telescope

(ATT). Firstly, an acute shortage of observing time hampered the ANU's Research School of Physical Sciences' work in the field of astronomy; secondly, the need for a large telescope versatile enough to take full advantage of modern instrumentation. There was also lack of advanced facilities for the training of students. Coupled with a desire to stimulate the development of astronomy in Australia, these factors provided the drive to design and build the new telescope.

Professor Don Mathewson, Director of Mount Stromlo and Siding Spring Observatories (MSSSO), devised the bold concept in the late 1970s and has seen it through to 'first light', achieved on 15 May this year. The original specifications, as outlined by astronomers and engineers at MSSSO, called for a versatile, precise, efficient

Siding Spring observatory from the air. The ANU telescopes are visible in the foreground. The large dome to the right houses the Anglo-Australian 3.9 metre telescope. The UK Schmidt facility is at far left.



established in 1924 by pioneer Australian astronomer, Dr W. G. Duffield, as the Commonwealth Solar Observatory. It was transferred to the ANU in 1957. Mount Stromlo is equipped with five optical telescopes. It has unique facilities for high-dispersion spectroscopy using the 1.9 metre reflector which was, until 1974, the largest telescope in the southern hemisphere.

Siding Spring Observatory. Located in the spectacular Warrumbungle Ranges near Coonabarabran, North-Western NSW, this facility was established in 1962 by Dr Bart Bok who did a great deal to stimulate the development of astronomy in Australia. There are four ANU telescopes at Siding Springs: The 2.3 metre Advanced Technology Telescope, a 1 m reflector plus 60 cm and 40 cm reflectors. The ANU also hosts the 3.9 metre Anglo-Australian Telescope, completed in 1974 and one of the most advanced and powerful observing instruments in the world, along with a 1.2m Schmidt camera owned by the UK Science and Research Council and the University of Uppsala's 20 cm Schmidt camera.

With a staff of 140, and extensive scientific and technical facilities, the ANU observatories together constitute one of the world's major astronomical research establishments.

telescope, to be equipped with advanced astronomical instrumentation, but costing a fraction of the price of a conventional telescope.

In all respects the new telescope meets the original aims of its creators, in many ways it surpasses those aims. The dream has been translated into reality, a reality that is an inspiring example of the capabilities of Australian scientists, engineers, and technicians — the concept is bold, the design is elegant, the implementation professional.

General features

I travelled to Siding Spring during late Easter, several weeks before the telescope was inaugurated. What confronted me there was a facility remarkably different from the other, conventional, telescopes on the mountain. Instead of the familiar domed

building, there stood a cubical building. Despite its dominating size, it is in fact smaller and considerably less costly than a conventional domed building would be for a telescope of its size. During use the telescope inside rotates, the building rotating with it, slaved to the telescope drive.

In a conventional telescope facility, the domed section of the building rotates as the telescope follows the apparent motion of the object being viewed. Instrumentation is mounted on the telescope, excepting when Coudé optics are used where the light is reflected out of the telescope and mount by a series of mirrors.

In the ATT, the instrumentation can be conveniently mounted in the building as a result of the design of the telescope optics and the building control.

A 2.3 metre diameter mirror is the heart

of the new telescope. The front surface of this 'primary' mirror has been precisely ground and polished to a concave shape and coated with a reflective layer of aluminium. Light falling on the primary mirror is reflected up to a smaller secondary mirror suspended near the top of the telescope. The secondary mirror reflects the light back down to the astronomical instruments mounted at the three focal points.

The primary mirror, which weighs two tonnes, is supported from behind by an airbed. A tubular band, containing mercury, encircles the mirror and supports it against sideways forces. (See Figure 1). The mirror cell is connected to the telescope's centre ring, and then to the top-end structure that supports the secondary mirrors, by a carefully engineered arrangement of tubular struts called a Serrurier truss. This truss

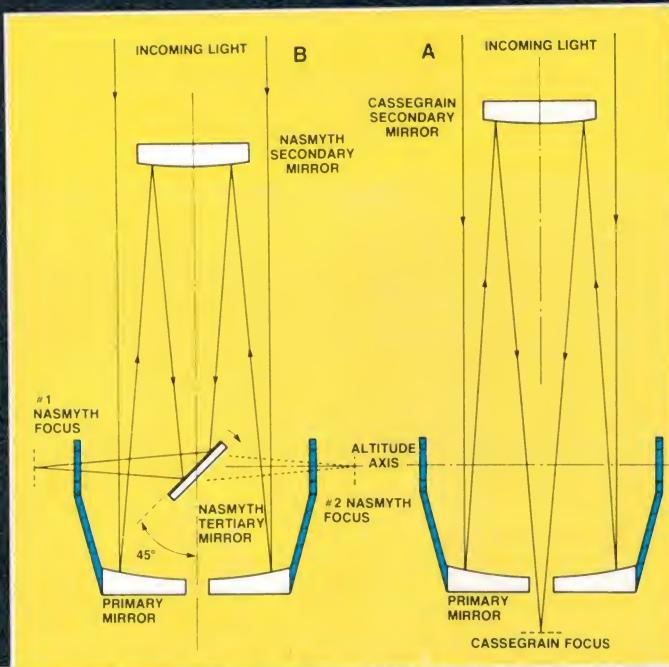
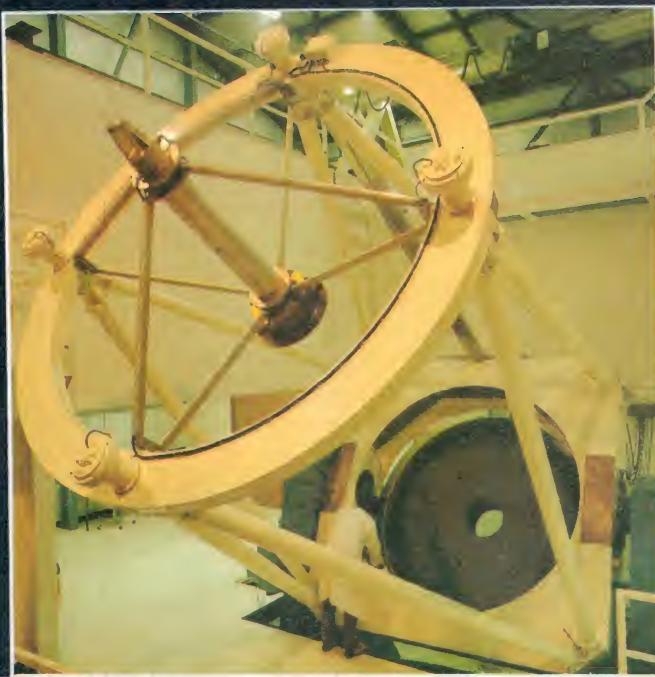


Figure 2. The telescope optics is capable of operating in two modes — Cassegrain (A) and Nasmyth (B). The latter has two focal positions, obtained by flipping the tertiary mirror. Note that the scale here is exaggerated.



Down the barrel. View from the top-end of the telescope. The four electric motor-driven top-end clamps are clearly visible. The primary and tertiary mirrors are not in place here.

maintains the mirrors in alignment as the telescope is tilted. Gravity, acting on the upper truss system causes it to 'droop' ever so slightly, which would throw the secondary mirror out of alignment, moving the focus point. The same goes for the heavy main mirror and its mount. The Serrurier truss, however, reduces the droop to negligible amounts while maintaining alignment of the mirrors.

The optics of the ATT make it an extremely flexible instrument. There are two configurations — Cassegrain and Nasmyth. The Cassegrain configuration is shown in Figure 2a. Light falling on the primary mirror is reflected back up to the secondary mirror. This directs the light straight down through a hole in the centre of the primary mirror to the 'Cassegrain focus'. It is intended that instrumentation for making observations in the infra-red will be mounted at this focus, at the rear of the mirror mount. Infra-red observations can be carried out day and night.

In the Nasmyth configuration, shown in Figure 2b, the converging beam of light from the secondary mirror is intercepted by a tertiary mirror and deflected out along the horizontal azimuth axis of the telescope mount. There are two Nasmyth focii, one on each side of the telescope. The observer can switch rapidly from one to the other by simply rotating the tertiary mirror. The Nasmyth focal stations remain stationary with respect to the rotating building, so large instruments and experimental equipment can be easily mounted there.

The primary mirror is made of Cer-Vit — a glass-like material that has a very low coefficient of expansion over a wide temperature range. It was purchased as a 'blank' from Owens-Illinois, who cast it, and ground to shape by the Norman Cole company, both of the USA. The University of

Arizona, OSC (USA) performed the optical testing.

The telescope has two complete top-end structures to accommodate the two different optical systems; one for the Cassegrain secondary mirror, one for the Nasmyth sec-

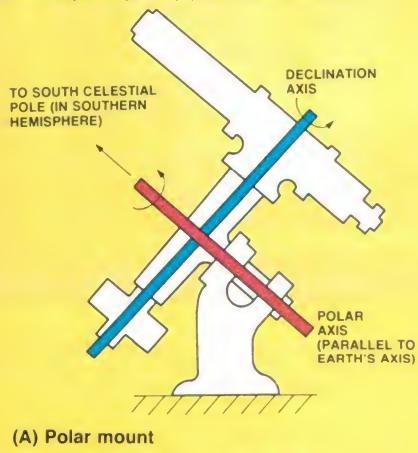
ondary mirror. The top ring is held in place by several small electric motor-driven lock mechanisms. These can be released and the top-end changed in twenty minutes so that the telescope configuration may be changed during an observing period.

THE DIFFERENT TELESCOPE MOUNTS

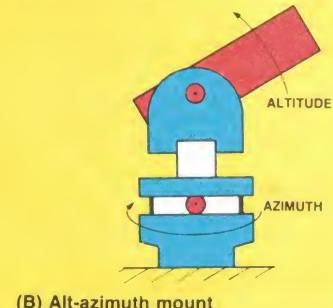
All telescopes need to be mounted so that they can be conveniently pointed at the object of interest and then rotated to compensate for the rotation of the Earth. There are two fundamental ways of doing this. The traditional method is known as the *polar mount*. As can be seen from the illustration on the left, the main axis is the *polar axis* which runs parallel to the Earth's axis and points, in the southern hemisphere, to the *south celestial pole*. This is a point in the sky about which the stars seem to rotate. The *declination axis* permits setting the telescope on the object. Once this is done, a drive mechanism rotates the telescope about the polar axis, slowly from east to west, maintaining the telescope on the chosen object despite the rotation of the Earth.

The illustration on the right shows the *altitude-azimuth* mount, or alt-azimuth mount as it is more commonly called. Here, one axis is vertical (azimuth) and the other horizontal (altitude). To maintain the telescope on the chosen object, both axes need to be driven. Obviously, this is a more complex drive system. Although attempted in the past, the complexity of alt-azimuth drive systems generally thwarted successful construction. Computer control of the drive system has changed that.

Figure 3. There are two main methods of mounting a telescope — polar (A) and alt-azimuth (B).



(A) Polar mount



(B) Alt-azimuth mount

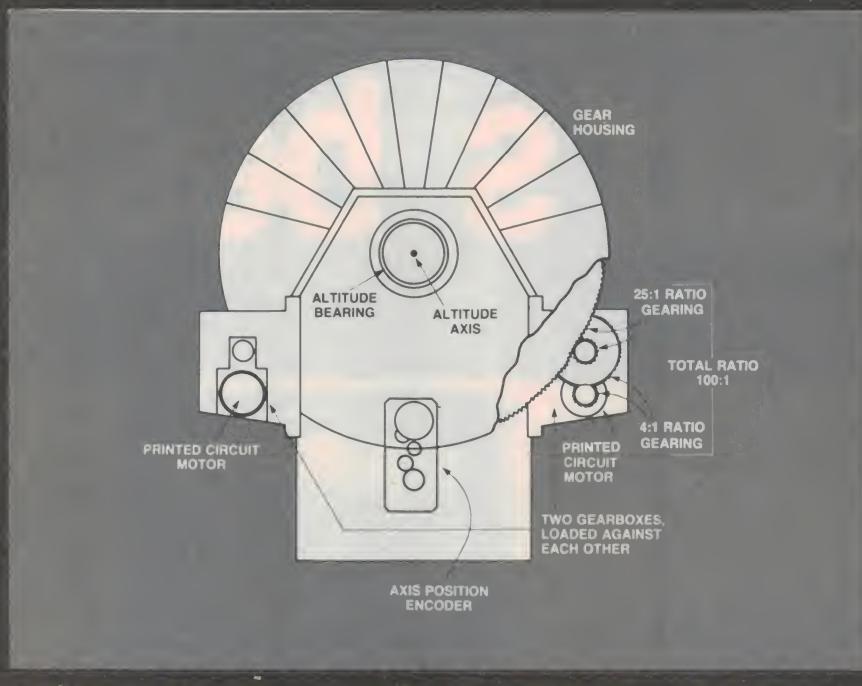


Figure 4. Details of the altitude drive mechanism. The two printed circuit motors are driven in opposite directions, 'loading' the two gearboxes against each other. Reducing the drive to one allows the other motor to move, driving the axis in the required direction. The azimuth drive is identical.

Telescope mount and drive

The telescope mount is 'alt-azimuth'. That is, it has one horizontal axis-of-rotation (the *altitude axis*) and one vertical axis (the *azimuth axis*). The basic scheme is shown in Figure 3b. Even though the moving parts weigh some 30 tonnes, the telescope can be slewed and pointed with extreme precision. More of that shortly.

The alt-azimuth drive was chosen as it offers simpler design and provides a constant load on the bearings. The bearings are pre-loaded and oil-lubricated with a pressurised system.

Two identical spur gear systems with printed circuit motors provide the drives for the two axes. This is a departure from previous practise. Drive systems for polar mounts almost invariably employ a worm gear and wheel system with a reduction ratio of 360:1, 720:1 etc. The ATT drive system employs a two-stage reduction of 100:1, which requires an extremely precise drive and servo mechanism.

The altitude drive is illustrated in Figure 4. Two printed circuit motors and their gear boxes are mounted 120° apart. The two motors have drive applied all the time, but rotate in opposite directions, 'loading' the gearboxes against each other to eliminate backlash. To move the telescope in any direction, the drive to the appropriate motor is reduced, allowing the other motor to move. The whole telescope assembly is carefully balanced so that the drive only has to act against inertial forces. During use, the telescope only moves at 15 arc-seconds per second, which is quite slow.

The telescope can be swung from the zenith (straight up, or 0° altitude) through to 72° altitude (18° above the horizon). The telescope cannot be swung any lower than that for two reasons. Firstly, the mirror would tip forward out of its housing (disas-

ter!). Secondly, astronomers prefer to view objects as high as possible as the atmosphere distorts the image and the less of it you look through, the lower the atmospheric effect.

The gear systems were made by MAAG of Switzerland and the bearings by Rothe Erde of West Germany.

The drive motors are servo-controlled, linked to a modern, high-speed computer. Positional feedback is provided by axis position encoders that measure the rotation of the telescope about its axis. The encoders, from the Baldwin company USA, are accurate to 0.05 seconds of arc, dividing one full rotation into 64 800 000 individual steps.

A Digital Equipment VAX 11/780 computer is the overall controller. This computer is connected to sensors and actuators on the telescope, the building, and the astronomical instruments. The control-computer can slew the telescope to the required position on the sky, set the acquisition camera accurately on the astronomical object, and operate the astronomical instruments.

The telescope control-console incorporates an image-processing computer that assists the observer in acquiring his programme objects. Compact, low-light-level television cameras attached to the astronomical instruments generate pictures that are displayed at the console. Objects can be selected by moving a small, computer-generated marker on the screen to the required position. The telescope will then set automatically to the position indicated.

One of the advantages of such a strongly computer-based design is that major changes to the operating characteristics of the telescope and its ancillary equipment can be made simply by altering the control programs. As a result, the telescope and its control systems can evolve in time, without

any changes being made to mechanical or electronic components. A telescope that can evolve, to meet changing observational needs, promises to be a highly versatile and efficient scientific tool.

The building

The cubical building is constructed on a circular steel base assembly. This is supported by four two-wheel bogies that run around a circular steel track beneath the building. A polygonal cement skirt encloses the track. Two of the bogies are driven by shunt-wound dc electric motors that run at stall torque when the building is in motion. As the motors run quite hot in this mode of operation, they have to be forced-air cooled. A section drawing of the telescope and building is shown in Figure 5.

The building itself is 14½ metres square. The steel-section frame is clad in 'Stramit', a lightweight, low-cost aluminium building material. It is painted white to reflect heat during the day. Being a lightweight material, it does not absorb much heat and can be cooled rapidly at night so that the building may be maintained close to outside air temperature during observations. Any rising hot air from the building causes distortion of the optical path, degrading the stability of the image during observations. Thermal considerations of the whole building were an important part of the design. The building is maintained to within a fraction of a degree of outside air temperature by huge fans which draw in air from the outside and blow it up through the building during use.

The main purpose of the building is to preclude any winds from buffeting the telescope during use for this would markedly degrade the image stability. A sliding 'shutter' opens for viewing. This rides on tracks on the outside of the building, driven by an electric motor. It takes 57 seconds to open.

The telescope and building can be rotated plus-and-minus 270° — chosen so that astronomers have full access to the sky. The azimuth drive is mounted on a concrete pier beneath the centre of the building. This pier is set several metres into the bedrock below. Overall weight of the building is 150 tonnes. A 'cable wrap' inside the pier carries all power, data and telephone cables up the centre of the telescope mount into the building. This prevents fouling or tensioning of the cables while the building is in motion. It can rotate plus-and-minus 320° while the building and telescope has a limit of +/- 270°. The cable wrap idea was 'borrowed' from that used in the CSIRO's Parkes 64 metre radio telescope.

The telescope drive is the prime drive in the whole system. A linear variable differential transformer (LVDT) sensor on the building provides servo feedback to the control computer regarding the position of the building in relation to the telescope. There can be a difference of up to 4° between the telescope and the building positions.

Inside, there are floors at four levels and a number of rooms. An infra-red laboratory is located on the level 2 floor (Figure 5). A Nasmyth laboratory is located on level 3 and the control and computer rooms are located on level 4.

On level 5 is stored the alternate top-end. ▶

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value computers



Apple IIe compatibility . . . but near half the price! That's The CAT. It's the best of both worlds: the very latest and most powerful hardware, plus the ability to run a very broad range of tried-and-proven software, particularly schools & business programs. And because we import direct, there's no middleman to force up the price. It really is outstanding value for money.

Check the CAT out at your nearest Dick Smith Computer City. It purrs.

Basic CAT Computer
Cat X-7500

\$699

That's near half the price of the Apple with similar features!



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New shipments arriving to meet huge demand . . . it's incredible!

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VZ-200 Computer Bargain!

This fantastic colour computer that's received rave reviews - now at this incredibly low price due to our high volume purchase power! Stocks are plentiful now, but at this price they won't last!

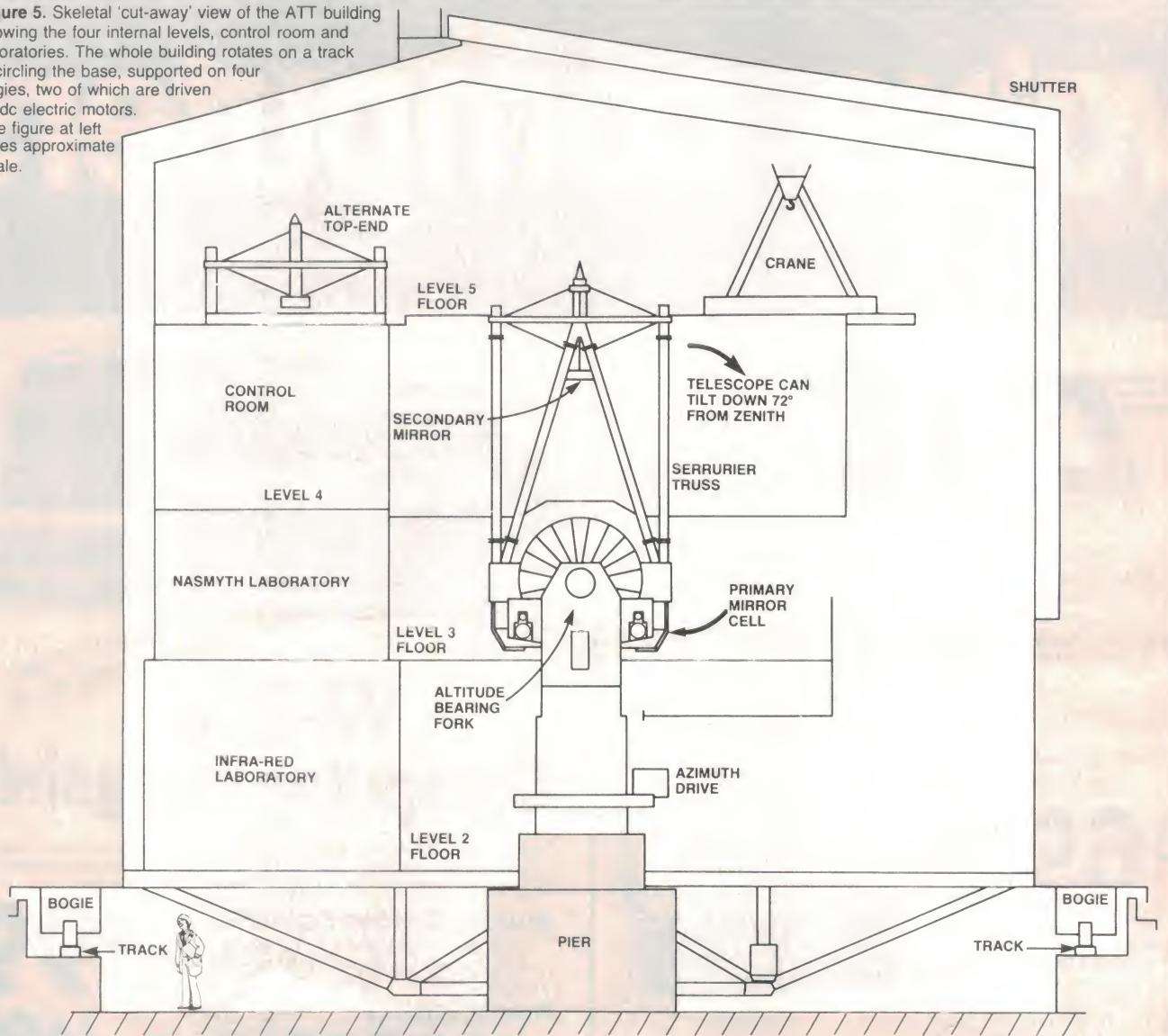
- **VZ-200 COLOUR COMPUTER** Complete with USER manual, BASIC manual & Demonstration Cassette. Ready to plug into your TV set. Cat-X 7200 **\$99**
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- **PRINTER INTERFACE** Lets you connect your VZ-200 to most standard Centronics-type printers such as our X-7208 below. Cat X-7210 **WAS \$49.50 \$31**
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See page for full address details



Figure 5. Skeletal 'cut-away' view of the ATT building showing the four internal levels, control room and laboratories. The whole building rotates on a track encircling the base, supported on four bogies, two of which are driven by dc electric motors. The figure at left gives approximate scale.



The crane for swapping top-ends is here, too. Instrumentation attached to either Nasmyth focus is mounted on the altitude bearing forks, with easy access from the level 3 floor where sundry instrumentation and equipment can be planted. Cassegrain focus instrumentation is mounted on the rear of the mirror cell. As detection instrumentation is predominantly electronic these days, subsequent signal processing and analysis equipment can be mounted in the nearby laboratory rooms.

The control and laboratory rooms are maintained at comfortable working temperatures during use. There's no point working in the cold when you don't have to! Lighting is arranged to retain astronomer's visual dark adaption while working. No fluorescent lights are used at such times, illumination of work areas being provided by dimmed incandescent lamps.

Instrumentation

The Australian National University is at the forefront of astronomical instrumentation

development. Engineers and scientists from the ANU have developed a Photon Counting Array (PCA) using charge-coupled devices (CCDs) that is very much a state-of-the art device. It was developed as part of the Starlab project (see ETI, May 1982, *Starlab — Australian-Canadian Ultraviolet Telescope*, pp 14-20). A charge-coupled device will generate electrons when struck by a photon — a particle of light. Excellent sensitivity and resolution can be obtained using such an array. Digital processing of the signal can enhance performance many times over, much more so than with optical photographic methods.

Spectrographic analysis of astronomical objects is of great importance in astronomy, providing many clues to the processes that occur in star systems. It is intended that spectrographic instruments will be mounted at either of the Nasmyth focii. Because the image rotates as the telescope moves to follow the apparent motion of the stars, an instrument 'field rotator' attached to the altitude bearing serves to 'de-rotate' the

image during observations as well as providing a facility to 'line-up' the image in a spectrograph slit.

The VAX 11/780 computer in the ATT building and other signal analysis/processing equipment can be used for on-line processing of the data. In fact, this can be done remotely, via a data link-up between the Siding Spring site and the Mount Stromlo facility at Canberra. This link-up can also provide remote telescope control. A 9600 baud DECNET terminal is installed in the ATT building at Siding Spring, linked by a permanent Telecom landline to Mount Stromlo.

Finale

Such is the success of the project's bold and radical approach that it has attracted international attention with visits from American, British, Dutch, Italian and Japanese scientists and engineers interested in building similar telescopes.

It is expected that the ATT will play a key role in the exploration of the universe.



Below. Building drive. The building rides on four bogies, two of which are fitted with dc electric motor-drives, like this one.



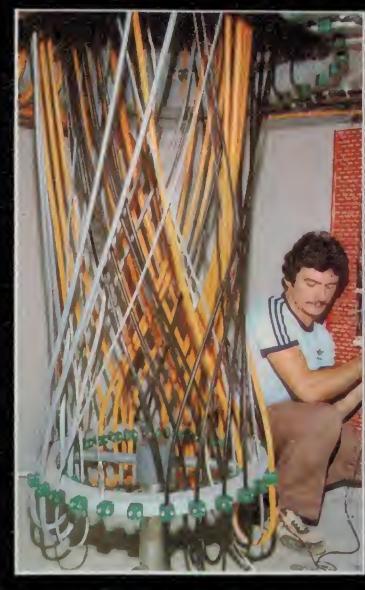
Complete computer control may allow, in the not too distant future, astronomers in different parts of the world to make use of the facility through satellite hookups. This sort of possibility offers considerable attractions, not just for Australian astronomical research. In concluding his address at the inauguration of the ATT, Mr Hawke said, "... I should like to pay tribute to the manifest commitment to excellence apparent in so much of the work of those associated with space activities. Your endeavours, in quite unprecedented fashion, probe the frontiers of human knowledge and experience. This telescope provides no better proof."

As acknowledged by the Prime Minister, the telescope owes its existence to the efforts of a large number of people. The astronomers who initiated the project, the officers of the Australian National University who provided the funding, the staff of MSSSO who created the reality, the staff of the Research School of Physical Sciences who assisted in the production, and the individuals

and companies throughout Australia and overseas who provided a wide range of services.

For MSSSO the telescope has been the epitome of an 'in-house' project. The scientific staff produced the original inspiration and specifications. The engineering teams worked steadily for a full five years to prepare detailed designs and drawings of thousands of components. The craftsmen of the mechanical, optical, and electronic workshops have converted those drawings into the final product, using all the skills at their command. The software engineers have written thousands of lines of computer code. The administrative and secretarial staff have provided the necessary logistic support for the technical work. Finally, to close the loop, the scientists have monitored and guided the development of the project. During the last year the pace has quickened to meet the final production schedules, but the team has not faltered.

The existence of the 2.3 metre telescope is a testimony to inspiration and hard work.



Far left. Up the barrel. View from the rear end of the telescope. The altitude drive is in the right foreground, the primary mirror cell is visible in the left foreground. Note the small size of the drive motors (see Figure 4).

Left. Cable wrap. All the power, data and telephone cables, attached to the 'fixed' outside world, are brought up the centre of the telescope pier and into the building via this cable wrap. As the building rotates, the cable wrap twists, preventing the cables being strained or fouled. The cables all pass down from the pier on the outside of the ring visible at the bottom of the picture, then up the inside of the ring to the telescope building.

Below. Control console. This is the astronomers' control console. It was designed and manufactured by the ANU's own workshop.



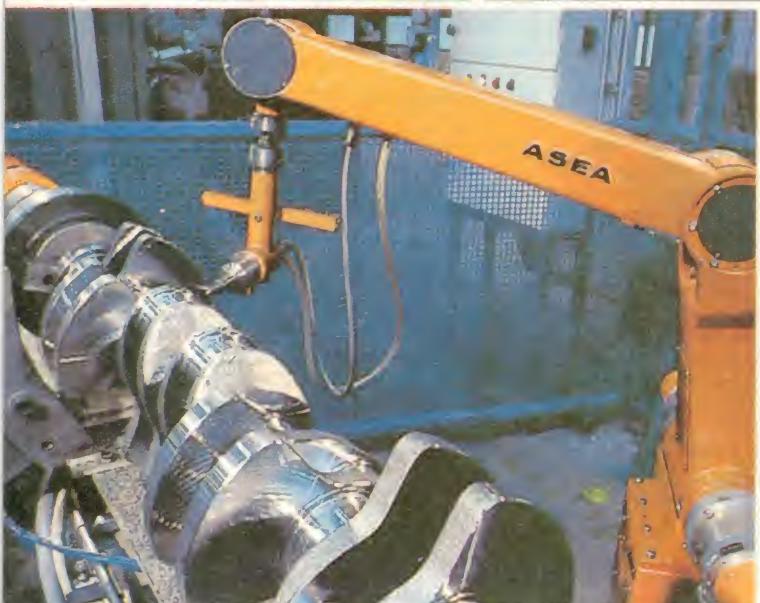
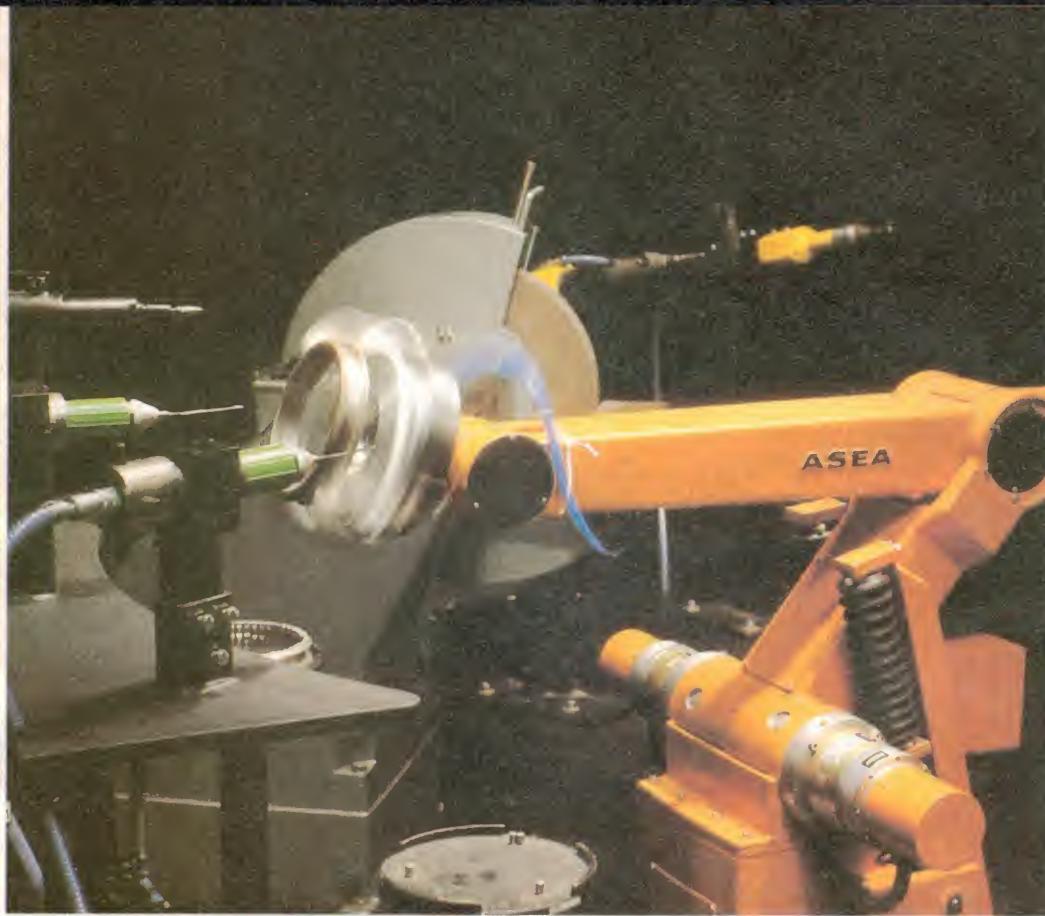
All those who have contributed to its completion can be proud of the accomplishment, whether they are members of the MSSSO team, the staff of the Australian National University, or the wider community. They will always share in the credit that the telescope brings to Australia.

Acknowledgements

In researching and writing this article, I would like to acknowledge the generous cooperation and assistance of a number of people. Firstly, my thanks go to Professor Don Mathewson, Director of MSSSO, who smoothed my path, introduced me to those who could best assist my task and arranged my visit to Siding Spring at relatively short notice. At Siding Spring, a number of staff gave generously of their time: Mary Gillingham, Andrew Arms and Herbert Wehner. Dr Barry Newell of ANU provided much-needed liaison, technical drawings and the magnificent photographs you see used on the front cover of this issue and throughout the article.

BARRY JONES TALKS ON

ROBOT



IS



The Hon. Barry O. Jones, MP, Minister for Science and Technology.

and the future of work

"If you robotise you lose 75% of the work force. If you fail to robotise you lose 100%, because the firm goes out of business."

BARRY O. JONES, MP, Minister for Science and Technology, was quoting union leaders in the United States during his address to the Australian Robot Association.

The Australian Robot Association held its Annual General Meeting, followed by dinner, at the Hilton International in Sydney on Saturday, April 7th.

Barry Jones was guest of honour at the dinner and addressed the Association and answered questions on the topic, 'Robots and the future of work'.

"As you know, in our Recovery and Reconstruction policy the Labor Party identified robotics as one of our sixteen 'sunrise' industries which deserved public support for future development.

"Of all the new technologies, the word

'robotics' probably has the most adverse reaction in most, if not all, of the trade union movements where the robot is perceived as a Threat with a capital 'T'.

"Robots are seen as a major threat to the future of work, or certainly to the traditional view of work.

"We have a strongly ingrained cultural belief in which 'work' is equated with 'process work'. Old views die hard. The stereotype idea that the typical Australian works on a production line in a factory is still very strongly held although labour force statistics prove to the contrary.

"After speaking at a dinner with some industry executives I asked eight senior people at my table: 'Of the 2 060 000 new jobs created in Australia in the period 1965- ▶



Take me to your union leader. Australia's Prime Minister, Bob Hawke, meets Matsushita's robot early this year in Japan.

What's a bright young lad



like you doing in the Army?

The simple answer of course, is that he's busy taking on all the responsibilities that come to young men bright and dedicated enough to succeed as Army Officers.

After that it gets a little tricky. Largely because once a young man completes his initial 44 weeks training at Officer Cadet School, Portsea, and graduates with a commission, his career can take a multitude of directions.

He might for example choose to enter an Infantry Battalion and become a Platoon Commander in charge of 30 men. In which case he'll obviously learn and be involved in different things to a man who flies a helicopter and commands a smaller crew. The same applies in areas like Armour, Artillery, Signals, Survey, Transport and Intelligence to name just a few.

There is, however, common ground on which every Officer stands. Irrespective of his rank or career choice.

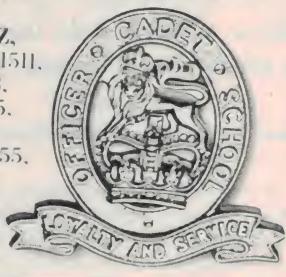
All Officers are constantly involved in improving their ability to make rational decisions, bring out the best in their men and achieve professional results. They're regularly faced with new situations, new problems to solve and challenges that test them both mentally and physically. So they can ill-afford to rest on their laurels. Once you become an Officer, the learning process never stops. There's always something to do and a better way of doing it.

In short, life as an Army Officer is exhilarating, varied and very satisfying. You're given every opportunity to realize your potential as a leader, and be recognised for your achievements.

If you're aged between 18½ and 23 on the first day of the month in which the course commences (or up to 25 with a degree or diploma), have your HSC or equivalent (at a level acceptable to the Army) and would like to know more about what bright young lads do in the Army, contact your nearest Army Careers Recruiting Centre or fill in the supplied coupon.

There are two courses per year: Applications close mid-March for a July entry and early August for a January entry.

For more information post coupon to GPO Box XYZ, in your Capital city. Sydney 2195555, Parramatta 6351511, Newcastle 25476, Wollongong 286492, Albury 552248, Lismore 216111, Canberra 822333, Melbourne 6979755, Geelong 211588, Bendigo 438008, Ballarat 311240, Brisbane 2262626, Townsville 724566, Adelaide 2121455, Perth 3256222, Hobart 347077, Launceston 311005.



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THE FUTURE OF WORK

82, what percentage were in manufacturing? The answers they offered were 25%, 30%, 30%, 35%, 40%, 70% and 80%. The actual figure is -7.3%, representing a net loss of 150 000.

"Our views on the centrality of manufacturing as an employment area are amazingly durable. This may reflect the goods orientation of our economic thinking — that only tangibles have value — and the traditional and erroneous prejudice of British economists that services don't create value and that the only things worth producing hurt if you drop them on your foot.

"There is currently a widespread fear that we face a general collapse of work. Like the reports of Mark Twain's death, this is premature.

"If it was about to happen in employment generally we could expect some early warning signs by now.

"However, there are some major, high specific areas where work *has* collapsed or is collapsing:

- unskilled male work
- juvenile work (male or female)
- work in economic monocultures — areas dominated by a narrow economic base — mining, steel, heavy manufacturing, fruit, sugar.
- Disadvantaged educational areas; places with the wrong postcode where schools act as a filter system to keep people out, where they certify and institutionalise a sense of incapacity.
- Some areas dominated by particular ethnic groups, especially where a high proportion of workers are in farming, manufacturing or construction.

"There has been a major shift away from physical work to mental work, from labour intensive physical tasks making and constructing things, towards more sophisticated

"There is currently a widespread fear that we face a general collapse of work. Like the reports of Mark Twain's death, this is premature."

tasks involving the manipulation of symbols (words, sounds, images, numbers). This fundamental shift is away from the production of tangible commodities, towards the production of intangibles — things which are not tied to a particular geographical location, which can be transmitted through the air or through a wire.

"The demand for unskilled labour has fallen dramatically except in the market supply of quasi-domestic activities.

"That is, the eating and drinking business, child care, cleaning and related tasks. We would be foolish to assume that such demand will ever return.

"There are two surprising factors — the rising labour participation rate and the stability of the 40 hour week. The labour participation rate, that is, the number of people aged 15 years or more in work or actively seeking it, has actually risen to record heights — about 62%.

"In the golden age of full employment the participation rate was only around 55%, overwhelmingly male. Since then women have entered the labour force in unprecedented numbers. Part time work has increased and 'moonlighting' and 'underground' (cash) work have to be taken into account too.

"The other surprising factor has been the extraordinary stability of hours worked.

"The demand for unskilled labour has fallen dramatically except in the market supply of quasi-domestic activities."

The 40 hour week became law in 1947 and has been operating for 37 years, by far the longest period without a change in hours in our industrial history, a remarkable fact considering the revolution in production we have undergone.

"It is true that in many industries the 38 hour week is now standard, largely through sweetheart arrangements and not because of a decision of the Conciliation and Arbitration Commission. However, for full time Australian workers the average working week (including overtime) is 41.6 hours.

"Will there be more or less work, in absolute terms, in the late 1980s and 1990s? We don't know yet. Society itself adjusts and evolves appropriate employment patterns. For example, Australia has the world's shortest working year of 229 days. Japan has the shortest working life time, 35-37 years, despite record and growing longevity.

"If there is one message that I would like to see left behind, engraved on my tombstone, it is this: 'Employment levels are essentially culturally determined'. It is postcodes that determine life chances and life outcomes far more than technology.

"Although I believe that societies have the capacity to determine appropriate employment levels there are enormous problems involved in retraining and significantly upgrading skills in the short term.

"We need to recognise that there are two completely different elements in changing the composition of the labour force.

- the decline of employment in process work and the production of tangible goods (and in this area, robots will speed up the process).
- the increase in employment in services where activity soaks up time.

"In the US new technologies enable fewer steelworkers on the production line, assisted by robotic techniques, to turn out far more than ever before, while an increasing number of hairdressers are performing highly personalised services aimed at specific customers on a one-to-one basis.

"The trend away from the employment of tangibles reflects the impact of the 'post industrial phenomenon'.

"In technologically advanced societies like Britain, the US, Germany and Japan, there have been three major stages in labour force trends.

"First, there is the traditional society where a majority of people spend most of their time, effort and earnings in producing or consuming necessities such as food, water and shelter.

"Second, with the Industrial Revolution, there is a dynamic growth in urbanisation and in the number of people employed in industry, with a sharp increase in energy usage and the creation of new industries making consumer durables, and equipment for transport, power generation, entertainment and communication.

"Third, there is the post-industrial transition where few people are *making* things and far more are *doing* things. Employment is dominated by the production of increasingly marginal, discretionary and interdependent services such as information, eating out, beauty care, entertainment, welfare, leisure and tourism.

"Robotisation will make enormous inroads into employment in process work in the 1980s. In Japan Nissan requires only 67 production line workers to manufacture 1300 cars per day. In 1984 the Kawasaki Company will open the largest machine tool factory in the world at Florence, Kentucky

"Technological change destroys jobs. Lack of technological change destroys jobs absolutely."

where it will employ six people. In 1985 the Japanese will open the first completely automated factory with no labour force at all.

"The fear of the unskilled about the impact of technology is largely justified, but there is no comfort in the view that rejecting technological innovation will preserve jobs. It will not. We cannot rely on an obsolescence-led recovery.

"Technological change destroys jobs. Lack of technological change destroys jobs absolutely.

"At Australia's present stage of technological development it is faced with a problem of 'truncated development' where much of the high volume production is dominated ►

by subsidiaries of foreign corporations; strategic decisions about industry are made overseas. The limitations — the truncation — were programmed from the beginning.

"The role of local producers is to be mere assemblers and packers of products designed by people overseas who are cleverer than we are. This leads to a branch office

"We fail to recognise the significant shift in world trade generally, and that the trend is towards high value-added 'brain-based' goods."

mentality, a passive and derivative technological culture, where the commanding heights are totally dominated by overseas interests.

"We cannot ask local representatives of overseas corporations to do the impossible and compete internationally. It is like asking invertebrates to show more backbone; they are not equipped to do it.

"It is an essential part of our industrial strategy that we assert our 'technological autonomy'; not, of course, as a 'unilateral declaration of independence' which would be absurd, but so that we could aspire to the contribution which is made to world technology by Sweden, the Netherlands and Switzerland, to name only three countries that have smaller populations than we do.

"We are specialists in shipping out high bulk low value-added goods — wheat at up to \$172 per tonne, iron ore at \$21, coal at \$55 — and we wonder why our share of world trade diminished so dramatically in the 1970s. We are inclined to say, 'It's just the recession', and leave it at that.

"We fail to recognise the significant shift in world trade generally, and that the trend is towards high value-added 'brain-based' goods.

"We measure our exports in tonnes. Our industrial contemporaries measure theirs in grammes. In the dollar value of agricultural products generally, excluding fishing and forestry, the United States comes No. 1 in the world. The Netherlands comes No. 2. They have used research to produce very high value-added products — seeds, bulbs, flowers, fine fruits, cheese, sera, vaccines and horticultural products — with a dollar value about twice that of ours.

"Australia has fallen in twenty years from No. 6 in per capita income among OECD members to No. 16. There are five priority areas which must be addressed urgently if we are to overcome the problems of 'truncated development'. Time is running out for us.

"1. Raising our skill base. In 1950 3.5% of our labour force entrants had tertiary qualifi-

cations and the Japanese figure was less than 1%. Australia's figure is now 8%. The number of Japanese with tertiary qualifications has increased to 35%, a 4000% increase. In the Republic of Korea it is predicted, confidently, that by 1985 40% of its labour force entrants will have degrees or diplomas.

"2. Bridging the gap between research and management. People in these two sectors do not relate to each other personally, intellectually or economically. They do not talk the same language. The lack of personal contact, made so obvious at the National Technology Conference last September, is at the core of the problem.

"3. Moving from low to high value-added products. The Canadians have done it in communications technology with some remarkable focussing of national effort in the past five years. Australia performs very badly in the dollar value of high technology exports. In 1980 the OECD average of high technology exports per head per year was \$468 (US). Switzerland ranked first of 24 nations with \$2584, followed by the Netherlands with \$1378 and Sweden with \$1087. Canada's figure was \$325, New Zealand's \$107 and Australia's \$81. We ranked 21st of 24 — only Greece, Iceland and Turkey were lower.

"4. Creating stronger/more appropriate economic infrastructures. Historically we have done well in research, poorly in development of research-based products (except in agriculture) and appallingly in marketing.

"Apart from the Hills Hoist, plastic wine casks and Violet Crumbles the inventory is bare.

"We have produced some wonderful industrial materials including PSZ (Partially Stabilised Zirconia), and our own custom made computer chips. But where are the

"Apart from the Hills Hoist, plastic wine casks and Violet Crumbles the inventory is bare."

industrial entities which can use them appropriately?

"Under tariff protection, many local companies have gone straight from the crib to the wheelchair without ever having been able to stand up and move on their own. The larger companies have been mostly under foreign ownership, classic illustrations of 'truncated development' that have been programmed not to compete; structural incapacity and non-competitiveness has been built into them.

"5. Overcoming regional problems. We are dogged by the problems of over-specialised regional economies devoted to heavy industry e.g. steel, coal and motor manufacturing and tinned fruit. Alternative areas of employment are not emerging.

"Workers face an unpleasant dilemma. Technological change is adding significantly to unemployment for the poorly educated, but existing modes of employment continue to exploit a fair-sized number of unskilled proletariat in unpleasant jobs. About one

"Post-industrial technology can provide enormous increases in output and raise consumption levels appreciably while decreasing the need for a large labour force."

worker in five is still physically disadvantaged by working conditions.

"However, we must reject the facile optimism that suggests that all displaced workers will find new and agreeable jobs in the brave new world. We appear to be exploiting much of the working class and unemploying an increasing part of it simultaneously.

"Post-industrial technology can provide enormous increases in output and raise consumption levels appreciably while decreasing the need for a large labour force.

"It is essentially a matter of choice whether the results of this change provide hardship or benefit for society.

"If we adopt a high-productivity plus low-employment mix, it will be necessary to provide economic, social and psychologically satisfying alternatives to work for the less gifted. This will involve the following moves on the part of society:

- recognition that work need no longer be the primary mechanism for the redistribution of wealth.
- education based on the personal needs of each individual rather than the industrial needs of the community.
- encouraging individuals to recognise the value of individually determined time use.
- developing new forms of participation and recognition.

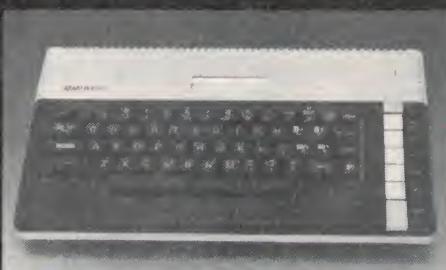
"None of these alternatives will be easy. But they are inescapable, and must be tackled immediately.

"Herbert Marcuse argued that post-industrial socialism — that is, communism — will adopt feminine values or it will not exist at all. This implies a cultural revolution replacing the principle of performance, the ethic of competition, accumulation and the rat race (the mouse race in Australia) with the values of reciprocity, tenderness, spontaneity and love of life in all its forms."

If you are interested in joining the Australian Robot Association contact Michael Kassler and Associates Pty Ltd, 9 Queens Ave, McMahons Point NSW 2060. (02)922-5026.

Preview to the Perth Electronics Show

Over 100 000 visitors are expected to crowd Perth's Claremont Showgrounds during the first week of August, elbowing each other in the crush to see what's new in audio, video, home computers, home security and car sound etc.



Strike up the band! Rising star in the home electronics galaxy is the electronic keyboard. Lowrey will be showing off their latest lines.



It figures. Major force in last year's show was Futuretronics. The Atari 600XL and 800XL home computers will future prominently this year, they say.



Video plus. The new plus for video recorders is hi-fi sound. Hitachi, wishing to forge to the foreground in this market, will have their new machines on-show.

OVER 100 exhibitors, about 20% up on last year, will be displaying recently released consumer electronics products of all descriptions. Many are expected to show as yet unreleased equipment, using the show to 'test the market', as had been done in past years.

Futuretronics will be showing off the Atari 600XL and 800XL models, no doubt hoping to lure potential buyers with news of their increased warranty period. From here on the Atari will be covered by a twelve months warranty instead of the old three month period.

The **Hitachi** stand will be jam packed full

of nice new goodies. The VT 7E infra-red controlled, fully portable, 4 head, 2 speed, video recorder will be there, as will the VT 88E hi-fi video. The VKC870E video camera with low-light capabilities and auto-focus should also attract the interest of videophiles. On the audio side, Hitachi hope to have the new DA 800 compact disc player and the HA 6 power amp available.

Pfaff will be taking their all-singing all-dancing, does-everything-but-talk sewing machine, the Creative 1469 to the show. The on-board processor allows the user to choose 16 stitch sequences delivered through 13 different needle positions, in 100

different patterns. It goes without saying that it can do buttonholes (seven different ways) and blind stitches (two types).

The organ specialists, **Lowrey**, will be out in force. Of particular interest will be the Genius Model G100, a small and deceptively simple looking electronic keyboard that can sound like a piano, guitar or accordian with equal ease. They will also have the portable Genie range on display complementing the top-of-the-range 'Holiday'.

Pioneer are launching a complete range of new automotive sound components. ●

Phone for telecommunications component innovations



Telecommunication equipment manufacturers face constant pressure for more and more user features. These pressures are accompanied by complex technical problems imposed by the highly sophisticated integration of business communications and information systems.

"New" equipment frequently becomes obsolescent, virtually from the first production run.

Elegant technical solutions, design flexibility and inherent reliability stem from the very latest "chip" and component technologies. So the long-term winners will be the companies who employ the most up-to-date and reliable electronic technology right from the start - moving their new designs smoothly into production.

This is where Elcoma fits in. It is precisely the

area in which we shine - innovation and reliability.

Our research laboratories in the UK, West Germany, France, Holland, Belgium and the USA are long established and internationally acclaimed centres of fundamental research.

Considering that our catalogues contain 200,000 products for all branches of the electronics industry - and our turnover, globally, exceeds our nearest competitor by over 50% - it is highly likely that Elcoma are already efficient suppliers to your needs.

If not, why not use your telephone to take advantage of our experience?

Sydney	427 0888	Melbourne	542 3333
Adelaide	243 0155	Perth	277 4199
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We make electronics in Australia

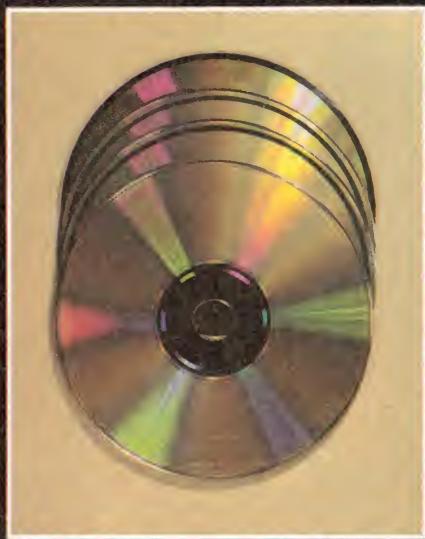


Electronic
Components &
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PHILIPS

CRYSTAL CLEAR

Sound from the Sanyo Compact Disc Player.



COMPACT
disc
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Sanyo CP400, the compact digital disc player that brings the finest crystal clarity of sound into your home. Forget the problems that come with conventional record turntables; Rumble, wow and flutter will be words from the past.

More and more discs are being released every day through all the major companies, from classical to pop and rock. Music to please every ear.

The Sanyo CP400 boasts microcomputer assisted soft push controls * 16 selection programmable auto search * Track sequence arrangement * 16-LED pick-up location indicator * Pause, access, reset, replay, fast forward and fast reverse * Full function wireless remote control and many more features.

Listen to the crystal clear Sound of Sanyo. You probably won't believe your ears - But that's life.



 **SANYO**
That's Life!

8mm — Chicago to decide

The Summer Consumer Electronics show in Chicago is going to be decisive in determining the immediate future of 8 mm video. Industry chiefs from both the US and Japan will be watching reaction to a range of new products in order to determine marketing strategy.

US companies have been more enthusiastic about the future of the product than their Japanese competitors. General Electric, Kodak and Polaroid are all selling models at prices from US\$995 up.

In Japan, however, a group of influential retailers has expressed concern at the timing and the wisdom of introducing 8 mm video onto the Japanese domestic market. Retailers are concerned that the product will sell in direct competition to video cassette recorders.

There is also concern that the technology for 8 mm video is still being developed. Standards for 8 mm cameras were only recently established at the sixth meeting of the 8 mm Video Conference in Tokyo. They decided to adopt the dual rotary azimuth head and fixed and rotary sound signal recording methods.

3D TV converter kit

Abdy Hoffman, a company in Hamburg, West Germany, is hoping to revolutionise television viewing with a 3D television converter kit which can be installed in an ordinary television set to give the picture 3D characteristics.

The Abdy 3D adaptor works by anaglyphic delay which means that it splits off and delays the TV transmission's red colour signals so that they appear on the screen a fraction of a second after the blue signals. The result is a TV picture that looks blurred and reddish to the naked eye. However, when viewed through a special pair of red and green glasses provided with the Abdy 3D kit, the TV picture appears to have added depth.

Unlike most previous experiments with 3D television, the

The recording time standard is to be 90 minutes for 525 line systems or 60 minutes for 625 lines. Both coated and metal evaporation tapes will be used. Big losers were the French, whose Timeplex system was abandoned by the conference.

There has been a considerable amount of technology transfer between the various companies involved in the development of 8 mm video, so the Japanese can probably afford to hold back on domestic production.

Matsushita, for instance, is closely tied in with Kodak. Toshiba is actually manufacturing several video-related products that Polaroid will distribute under its own name. At present, no Japanese company has plans to release 8 mm equipment with its own badge.

But all this could change if there is an enthusiastic response in Chicago.

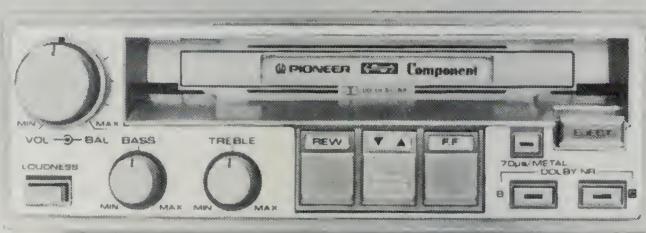
Hoffman technology works at the point of reception, not at the expensive transmission stage. This means that the viewer has a choice of watching an ordinary television broadcast or, with the flick of a switch, one with the 3D special effects.

Abdy Australia is distributing this kit as an add-on component which will be sold by retailers and selected TV service shops. The kit works with RGB drive colour TV receivers but not with colour difference drive receivers.

The cost of the system, including anaglyphic glasses and without installation, will be about \$130. Installation can be arranged for about \$35.

For more information contact **Abdy Australia, 457 Sydney Rd, Balgowlah NSW 2093. (02)949-2454.**

Car cassette



The new KP818G cassette deck from Pioneer.

Pioneer has released its new KP818G top-of-the-line cassette deck, featuring Dolby C noise reduction and a wired remote control.

It is intended as a companion to the nine-band CD9 graphic equaliser which joined the Pioneer car stereo component range late last year.

The provision of a Dolby C circuit in addition to the familiar Dolby B system, combined with

the inclusion of a Ribbon Sendust Head, allows the KP818G to achieve 70 dB signal-to-noise ratio and expands the frequency range and reproduction quality. The deck also features full metal tape compatibility.

The Pioneer KP818G has a recommended retail price of \$385. For further information contact **Pioneer Electronics, 178-184 Boundary Road, Braeside Vic 3195. (03)580-9911.**

Latest in Sennheiser headphones

When Sennheiser introduced the first open stereo headphones in 1968, the sales estimate for the entire year was 950 units. However, about three million of the HD 414 headphones were sold.

In February 1984 Sennheiser introduced the successor to the HD 414 which has been designated the HD 414 SL. There

have been improvements in both user comfort and technical design.

A lighter swing coil has perfected pulse reproduction so that the HD 414 SL can cope with the signal of the CD era in an outstanding fashion.

For more information contact **R. H. Cunningham Pty Ltd, P.O. Box 4533, Melbourne Vic. 3003 (03)329-9633.**

The new Sennheiser HD 414 SL.





Hear digital perfection.

Introducing the Sony Compact Disc Player

When we used our long experience in digital technology to create the CDP-101 Compact Disc Player, we wanted to give you something more than the world's clearest sound.

WIRELESS REMOTE CONTROL Full-function remote control.

3-WAY MUSIC SEARCH Instant direct access to any selection with the 10-key pad on remote control unit. AMS (Automatic Music Sensor) allows access to the beginning of next or previous selection. 2-speed bi-directional search to find any desired music passage.

REPEAT FUNCTION Program to repeat the entire disc, one selection, or a specific portion of music.

3-FUNCTION DIGITAL READOUT DISPLAY Selection number. Time lapse of selection being displayed. Remaining time on the disc.

LINEAR SKATE DISC LOADING Just press the button, platter control and cueing are automatic.



SONY®

Fast sound maker

Trio-Kenwood Corporation will again be participating in the Le Mans endurance car race as the main sponsor of the Kremer Racing Team.

Following a brilliant performance at Le Mans last year, Trio-Kenwood Corporation, under the leadership of its president Mr Kazuyoshi Ishizaka, is to sponsor the Kremer Team in the '84 race that is scheduled in June.

Last year, the Kenwood Team came in a very close third behind the Porsche Factory Team with an exceptional performance by the internationally known drivers Philippe Alliot and father and son combination, Mario and Michael Andretti.

Two new Naks

Nakamichi is introducing two new cassette decks onto the Australian market. The BX-150 two head cassette deck and the BX-100 two head cassette deck are priced competitively with decks in the low/middle end of the market but the maker claims superior performance based on a design philosophy that emphasises the four essentials: transport, heads, electronics and quality control.

The BX-150 and BX-100 feature Nakamichi's tried and proven Single-Capstan 'Silent Mechanism'. The makers claim unusually low wow and flutter because of the functional independence of the capstan, reel,



The new Sanyo CD player the CP300.

Sanyo Laser

Compact Disc (CD) Players use a laser to play a small disc capable of playing up to one hour of pre-recorded material. This technology removes the possibility of distortion through wear and provide enhanced dynamic range. Sanyo's CP-300 boasts a dynamic range of more than 90 dB, making it the per-

fect sound source for the audiophile's hi-fi system.

This slim-style CD Player features a horizontal slide loading system and soft-push controls, the functions of which are carried out by a microcomputer. To save both the player and discs, the auto-eject function is activated if the disc is loaded

incorrectly.

A 16-selection programmable auto search system saves time and effort in locating tracks, and programming is done by a one-touch control. A flashing LED indicates the number of the track that is being found or played.

Danish speaker stands

Scan Adio in Melbourne are now introducing a range of fully imported loudspeaker stands from Denmark.

Many high quality loudspeakers are often put directly on the floor. This results in a boomy bass reproduction due to reflection of the lower frequencies from the floor.

and transport drives and the inherent quality of each.

Three high-performance DC motors power the transport system: one for the capstan, one to provide take-up torque, and a third to operate Nakamichi's motor-driven cam control system.

Both decks feature Dolby-B noise reduction with defeatable MPX filter; The BX-150 also includes Dolby-C NR. Suggested retail price of the BX-150 is \$499. The BX-100 is worth \$399.

For more information, contact Geoff Matthews, Marketing Director, Convoy International, 400 Botany Road, Waterloo NSW 2017. (02)698-7300.

They Shure are!

Several new Shure products are now available from Audio Engineers. The Shure Automatic Microphone System (AMS) consists of the AMS8000 or AMS4000 mixer used with Shure AMS microphones.

The system is suitable for multiple-microphone public address and recording systems. It is claimed that it will solve many problems associated with multiple-microphone installations by turning on only those microphones in use. When a person

speaks within 60° of each side of the front of a microphone it will turn on.

The AMS8000 mixer has eight microphone inputs and the AMS4000 mixer has four microphone inputs.

The Model AMS22 condenser microphone is designed for use only with the Shure automatic microphone system. It is a low-profile surface-mount unit with a hemi-cardioid polar pattern.

The SM83 professional omnidirectional condenser lavalier microphone has been designed to provide sound reproduction in professional broadcasting, film and related sound reinforcement applications. It has an electronically created dip at 730 Hz to overcome the chest resonance phenomenon and an acoustically generated high-frequency boost above 3 kHz.

Another Shure product is the FP31 compact, portable microphone mixer specially designed for electronic news gathering and electronic field production use, including film, video and remote broadcast applications.

For more information on these products contact **Audio Engineers Pty Ltd**, 342 Kent St, Sydney NSW 2000. (02)29-6731.

called Mini, Midi and Maxi, are all made in aluminium profiles and are thus very rigid. Speakers up to 35 kg can be used on them. The recommended retail prices are respectively: \$65, \$80 and \$95 per pair.

More information is available from **Scan Audio**, P.O. Box 242, Hawthorn Vic. 3122. (03)819-5352.

The new speaker stands,

AIWA F990 cassette recorder

A processor controlled, automated cassette deck from Aiwa. It has an unusual panel layout in front of one of the best tape movements available today. Subjectively, this is hard to beat.

Louis Challis



OVER THE LAST three years we have seen a remarkable trend in what we perceive to be the Japanese design philosophy for compact cassette recorders. Whilst Sharp and Nakamichi have tended to set the ground rules in this particular area, we have noted with interest that Aiwa have also introduced a number of unusual and innovative concepts. These were initiated in their 6900 series recorder, at the time of its release one of the finest cassette recorders on the market. In the intervening period many other manufacturers have copied the Aiwa concept and introduced machines with many 'look-a-like' characteristics.

The Aiwa Stereo Cassette Deck is a particularly good example of the extent of electronic sophistication in the latest generation of cassette recorders achieved by generally sensible and innovative utilisation of microprocessors.

The philosophy underlying the design of this recorder is to provide as many automated facilities as convenient whilst still providing a machine which requires the minimum degree of familiarisation by the user. This concept can be self defeating as there are some functions that should not be automated where the automation results in a positive loss of effective control.

The F990 cassette recorder provides such automation but loses some flexibility, as I discovered during the course of my assessment. As if to underscore that viewpoint the appearance of the F990 is quite different to any of the previous cassette recorders that I have reviewed. The most significant difference between this and other cassette recorders being the number of flashing lights and

semi-automated or automated controls.

The first difference that I noticed is that the controls are organised not just on two levels as practised in many cassette recorders, but in two distinct planes, one vertical and one horizontal. The vertical plane incorporates the least often used controls and most often viewed displays, whilst the horizontal plane incorporates the most often used controls whose use necessitates the user's proximity to the unit, unless you're using the optional remote control (which was not supplied with the unit).

The front panel is an attractive combination of plastic and metal with the emphasis being on black plastic and smoked finishes, so that the illuminated displays stand out more sharply. At the extreme left hand of the front panel are the power and the smoothly operating cassette well ejection button. Immediately below this is the timer play/repeat and record control which allows you to automatically play, repeat or record when the unit is switched on by an externally programmed timer.

The cassette well and the drive in the F990 are undoubtedly one of the paragons of the currently available cassette recorders. One significant difference between this unit and others is its use of a three head recording-play-back configuration with what are described as "pure amorphous alloy heads". This head configuration is supplemented by an automatic demagnetising system which demagnetises the heads each time you switch on the recorder. This obviates the problems that most cassette recorders have with a slow but steady operational magnetisation of the heads (which is a com-

mon problem with all conventional magnetic tape recorders).

Most of the remaining areas of the front panel are taken up by displays, which although they look complex at first sight, soon separate themselves into a series of primary display areas.

At the top left hand corner of the main display is a four-digit counter which can be switched to also indicate the remaining playing time in minutes and seconds. To achieve this aim you have to use a tape length switch on the lower horizontal escutcheon which you sequentially push to set the appropriate illuminated bezel to indicate C60, C90, C120 or C46 configurations. The cassette recorder has no other way of knowing how much tape or what length of tape is actually inside your cassette.

At the top centre of the unit is a fluorescent display on which is located a series of red segments. These are programmed to indicate the recording level setting chosen by means of a digitally programmed attenuator on the main sloping panel. These controls replace the normal rotary attenuator and provide a series of ten, 2 dB steps for setting the input signal levels. Below the attenuator display are two blue fluorescent displays which provide the peak programme meter function and which cover the range -22 to +10 VU. This display incorporates a temporary peak hold function (typically three seconds) so that instantaneous transients levels can be compared against the average recording levels.

In a large display section which is located below the timer and peak programme meter is a display also indicates whether the automatic selection and detection of tape equalisation has been correctly carried out. This provides information about a series of electronic functions that few other cassette recorders currently incorporate. The first of these is the "ADMS" or Automatic Demagnetising System. The second is the "INTRO PLAY" system which when selected in conjunction with the play and either fast forward or rewind searches for the first eight seconds of each recording. It then plays at normal speed before searching for the next eight seconds of the next recording. During this search mode the "INTRO PLAY" light flashes.

The next feature is the "MUSIC SENSOR" system which locates blank sections recorded on the tape before and after each recorded section. When the MUSIC SENSOR button is selected and PLAY button is selected with either FAST FORWARD or REWIND buttons, the recorder will find the start or the next or last number, to allow it to be rapidly reviewed and played.

This particular electronic control can experience a number of different problems which interfere with its normal operation. If the recording contains extended passages at low volume, or if the blank passages before

And after recorded sections are either extremely long or extremely short in duration, it can be 'fooled'.

The most complex automated system incorporated in this recorder is the Automatic Tape Adaption System (ATAS). This is provided to adjust the cassette recorder's operating parameters (bias and equalisation) to match the characteristics of the recording tape actually being used. This ATAS system involves the clever utilisation of a microprocessor to optimise the recording parameters in a simple but very rapid step-by-step process. To activate the process all you have to do is load the tape and press the DATA SYSTEM start/reset button. The adaptation system then checks four parameters.

The first of these is the recording sensitivity which is checked by feeding in a 400 Hz test signal. The playback output must exceed a predetermined limit. The second stage involves checking the bias adjustment by feeding in a combined 400 Hz and 10 kHz test signal. The recorder adjusts the bias so that the 10 kHz play back level is at the same level as the 400 Hz signal. The third adjustment is the recording sensitivity adjustment which involves feeding in a 400 Hz test signal at -17 VU and then internally adjusting the recording chain so that the playback signal matches the -17 VU signal. Finally, equalisation is optimised by feeding in a 13 kHz test signal at -17 VU. Equalisation is adjusted so that play back output level is set to the optimum point. This whole cycle takes only 14 seconds and after completion the display proudly proclaims "READY".

If you don't change your tape and you continue utilising the same brand, the optimised settings are retained for the given type of tape for up to 24 hours. Even turning off the recorder does not result in the loss of the settings.

The next automated facility provided in the recorder is the automatic (as well as the manual) selection of Dolby B or C noise reduction systems.

When recording a tape on this recorder for the first time, the recording chain encodes one of two infra-sonic signals to tell the recorder during subsequent replay which choice of noise reduction (Dolby B or C) was made. On replay the cassette recorder automatically selects the proper noise reduction system. Obviously, this only works with cassettes recorded on this type of machine and pre-recorded cassettes have to be manually selected.

Another unusual feature in this recorder is the incorporation of the Dolby HX Professional automatic adjustment system ('HX PRO'). This particular system was developed by Band & Olsens of Sweden. It works on the basis that at the highest recording levels the high frequency components are attenuated as a result of the interaction of the high frequency signal. The Dolby HX PRO system overcomes this problem by reducing the bias signal in the presence of high level and high frequency

signals to ensure a flatter frequency response. This improves the critical 3-10 kHz region where a drooping frequency response would otherwise occur. This is the first non-professional recorder in which I have seen the Dolby HX professional system and it works exceedingly well.

One feature that did not immediately strike me as being such a good one is the incorporation of an automatic tape format detector. This is intended to set the bias and equalisation conditions for record and replay in accordance with the presence (or absence) of the appropriate detection slots on the back of the cassette casing. Regrettably this recorder is not designed to provide for user adjustment and consequently old tapes without the appropriate slots will not receive the appropriate bias and equalisation.

Instead of a normal recording level control (a rotary or sliding potentiometer) the right hand side of the deck incorporates three buttons. These provide either fully automatic and internal selection of recording level, or provide either fully automatic and internal selection of recording level, or provide a manual adjustment by means of a pair of up/down buttons which control the attenuator in a series of ten precise 2 dB steps.

The only other significant controls on the front panel are the output level control and the recording level balance control, each of which is a small rotary attenuator.

The rear panel incorporates two unbalanced microphone sockets with standard tip-and-sleeve format and a 1 mV sensitivity for microphones with impedances lying between 200R and 10K. The inputs and outputs utilise four RCA type coaxial sockets. The back panel also incorporates a multiplex filter switch for removing the pilot tone signal from FM broadcast recordings and a remote control socket for which no other data is provided.

The inside of the unit features one large "mother" printed circuit board to which are attached six satellite boards. As well as these there are two other supplementary printed circuit boards behind the front panel. These boards cumulatively contain 61 ICs, 116 transistors, 138 diodes, 20 LEDs, one and two fluorescent plasma displays.

The extent of interwiring required to interconnect all the circuitry on the boards reminds me of the first radio I built more than 30 years ago. Admittedly this recorder is far more complex than the equipment I built, but the extent and number of wiring harnesses required in this particular recorder is far more than I would have expected and much greater than I have seen on any other recorder in recent years.

One feature which surprised me was the extent of the temperature rise on one of the internal heatsinks at the rear of the main printed circuit board. I suspect that the thermal rating and efficiency of this particular sink is lower than desirable.

The main cassette drive mechanism is

exceedingly well executed and the solenoid controls are extremely efficient and rapid in their operation. The designers have gone to considerable trouble to reduce the effects of mains flux leakage and the control of residual hum. The wiring and internal electrical design meet all the safety features specified by the double insulated standards in AS3100-1982 and AS3159-1980.

On test

Objective testing of this particular cassette deck provided some of the most interesting and unusual results we have seen for some time. The first and undoubtedly the most outstanding feature of this deck is its *replay* frequency response. Utilising a TDK-SA reference tape provided a frequency response that was ± 3 dB from 15 Hz to 12 kHz at 0 VU, 13 Hz to 21 kHz at -10 VU and 13 Hz to 21 kHz at -20 VU. With a pre-encoded Dolby B reference tape, the frequency response of 0 and -10 VU was remarkably linear but the differences between the reference Dolby encoder and the decoder in this machine is quite apparent and even more evident at -20 VU. Even so, the frequency response is still quite good although the mid-frequency non-uniformity is quite apparent between 600 Hz and 2 kHz.

With a pre-encoded Dolby C reference tape however, the differences between the respective encoding and decoding circuits became quite pronounced. At zero VU the measured frequency response was particularly good. At +10 VU there is an obvious droop in low frequency and high frequency responses resulting in a slight reduction in overall bandwidth. At -20 VU there was an obvious marked difference between the encoding circuit of the reference tape recorder and the decoding circuit of this particular tape recorder. The resulting frequency response is almost unacceptable on an objective assessment basis.

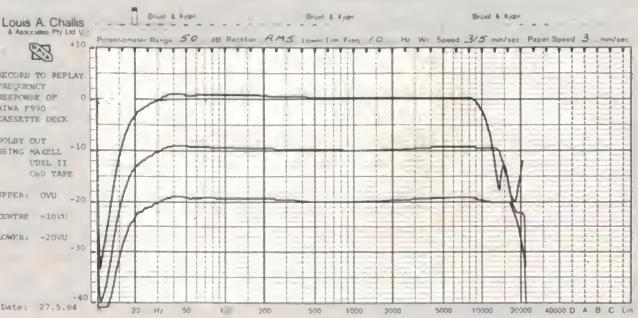
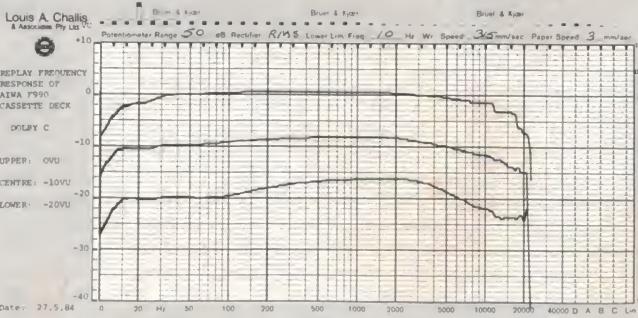
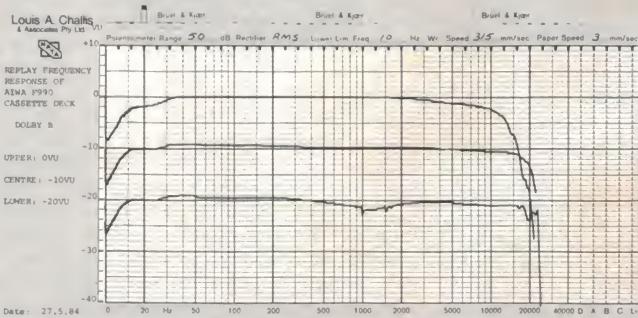
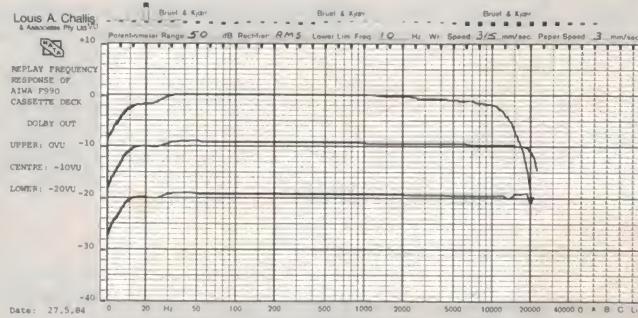
It is interesting to note that in the record-to-replay test sequence the frequency response at both low frequency and most particularly, at high frequency is not quite as good as I would have expected based on the electronic potential that is promised. Thus, although the frequency response is remarkably flat, at -20 VU it only extends typically to 18 Hz or 20 Hz at the low end and approximately 17 kHz at the top, almost irrespective of the tape formulation chosen.

Given the time available I decided to evaluate the record-to-replay frequency response with "Maxell UDXL 2" tape at the three recording levels and with Dolby OUT, Dolby B and Dolby C.

With the automated ADMS system activated, and selected prior to the record/replay process for each tape, the frequency linearity achieved by the ADF990 cassette recorder is *quite outstanding*.

The frequency responses are, by and large, almost ruler flat from 30 Hz to 9 kHz and the responses at -10 and -20 VU are equally good, providing a true 17 or 18 kHz ▶

SOUND REVIEW



effective bandwidth. With Dolby B the response is nearly as good, although there is a slight lift in frequency response in the 2-10 kHz region. With Dolby C the results are generally acceptable although there is a small droop in the frequency response between 9 kHz and 15 kHz.

Taken overall these frequency responses are exemplary, although not quite as good as I would have expected from the manufacturer's literature. It should be pointed out that the frequency responses quoted in the literature does not talk in terms of -3 dB levels.

AIWA F990 Dimensions:

420 mm wide
by 110 mm high
by 280 mm deep.

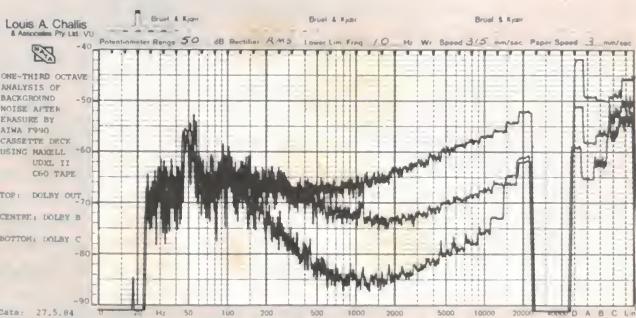
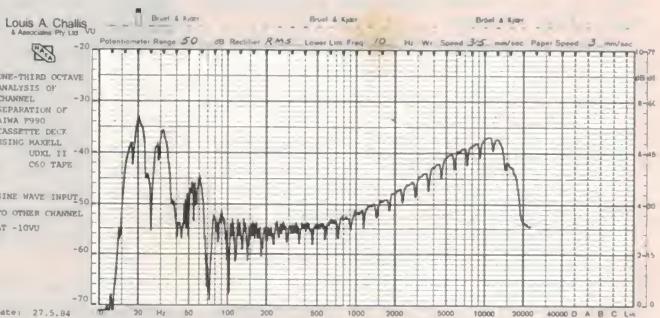
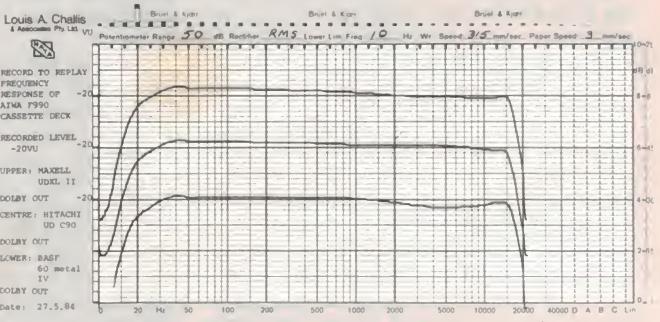
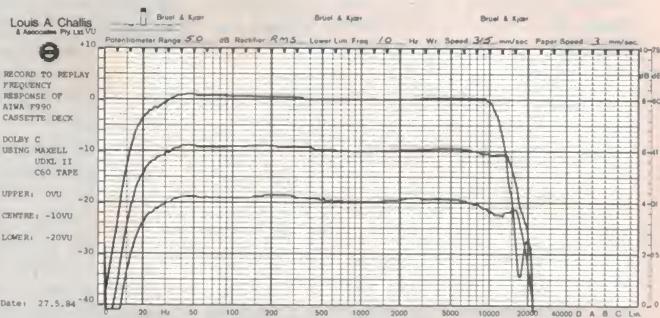
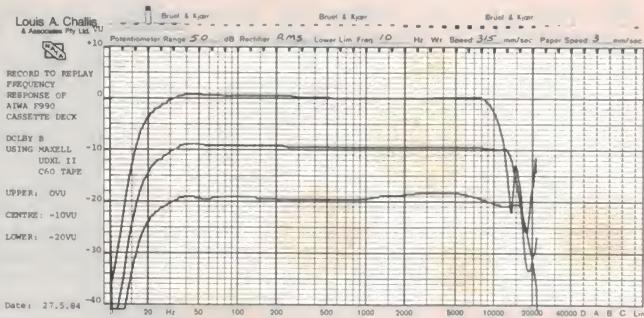
Weight:

5.5 kg

Price:

\$749

Manufacturer:
Aiwa Company,
Japan.



MEASURED PERFORMANCE OF AIWA MODEL F990 CASSETTE RECORDER

S.N. 31212028

REPLAY FREQUENCY RESPONSE AT -20VU

Tape	Dolby	Lower - 3dB	Upper - 3dB
		Point	Point
TDKSA	OUT	13 Hz	21 kHz
	B	13 Hz	18 kHz
	C	15 Hz	6 kHz

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU:

Tape	Dolby	Lower - 3dB	Upper - 3dB
		Point	Point

MAXELL UDXL II OUT 19 Hz 17 kHz

SPEED ACCURACY:

-3.6%

WOW AND FLUTTER:

<u>WOW:</u>	Average	0.05% Peak to Peak
<u>FLUTTER:</u>	Unweighted	0.04% RMS

Weighted 0.02% RMS

HARMONIC DISTORTION:

Tape:	MAXELL UDXL II		
	100Hz	1kHz	6.3kHz
OVU:	2nd -43.5	-56.3	-52.9
	3rd -48.2	-62.0	-40.8
	4th -65.4	-64	-59
	5th -65.7	-62.3	-
	T.H.D. 0.7%	1.9%	0.95%
	-6VU:	2nd -50.3	-57.4
	3rd -54.7	-61	-52
	4th -66.5	-62.5	-56
	5th -68	-64	-
	T.H.D. .36%	0.19%	.35%

MAXIMUM INPUT LEVEL:

(for 3% third harmonic distortion at 1kHz)

Tape: Maxell UDXL II +10 VU (Dolby Out)

DYNAMIC RANGE:

Tape: Maxell UDXL II

Dolby Out	56 dB(unweighted)	59 dB(A)
Dolby B	61 dB(unweighted)	68 dB(A)
Dolby C	64 dB(unweighted)	75 dB(A)

ERASURE RATIO:

(for 1kHz signal recorded at OVU)

Tape: Maxwell UDXL II

Tape: BASF 69 Metal IV

-90.5 dB

-84.5 dB

Date: 27-5-84

One problem

It was during the subjective evaluation of the record to replay frequency response that I experienced my first and only problem with this recorder. The problem relates solely to the automatic tape selector function which is incorporated in this deck. This tape selection function operates perfectly when you are utilising the current generation of tapes (i.e. tapes produced within the last two to three years). It is incapable of correctly functioning if you own or utilise tapes that were produced more than three years ago. Surprisingly as I discovered, all but two of my metal tapes were pre-1982 vintage! Most of my other cassette tapes were either purchased, recorded or provided by the tape manufacturers with test tape material prior to 1981 when the industry standards for the holes to activate metal type or chromium type tape selector switches were ratified.

Whilst I was able to overcome the problem by selecting from these tapes that I do have with the correct selector hole incorporated, I experienced a short periods of distress whilst I wondered what I was going to do to evaluate the automatic tape selector function capabilities of the deck. As the deck has no other way of selecting the appropriate bias and equalisation, you would be disadvantaged when trying to achieve the full potential of this deck using your old tapes.

The other measured performance characteristics of this recorder are particularly good. The wow figure is quite low 0.08% peak-to/peak whilst the flutter is only 0.04% RMS unweighted or 0.02% RMS weighted.

The speed accuracy is a trifle low at

-3.6% which is the only objective test result at variance to normal tolerance. The distortion figures are all low; lower than 1% for the three test frequencies at 0 VU and at -6 VU. The maximum output level for 3% distortion, even with UDXL type 2 tape, is +10 VU, which is particularly good. The dynamic range of the recorder is thus 56 dB unweighted and 59 dB A-weighted with Dolby out, whilst at the other end of the spectrum is 64 dB unweighted and 75 dB A-weighted with Dolby C, which is excellent.

The erasure ratio is a very healthy -90 dB with UDXL2 and an excellent -84.5 dB with a BASF F60 metal type IV tape. The channel separation is particularly good being better than -50 dB at mid-frequencies and better than -33 dB at all frequencies from 20 Hz to 20 kHz.

Taken overall, the objective performance of this machine is exceedingly good with its most outstanding feature undoubtedly being its replay frequency response.

Subjectively

The subjective testing of this machine was far more pleasurable than I would have expected. The machine provides a quality of reproduction which is truly outstanding. Using a series of pre-recorded cassette tapes specially provided by other manufacturers, as well as a series of special recordings that we produced precisely for this purpose last year, it was very evident right from the outset that the recorder incorporates a series of user functions and achieves a level of sound reproduction which is quite outstanding.

After a period of two days of putting the machine through its paces the following points are very clear:

1. That the replay response is superlative and utilizing properly recorded or pre-recorded tapes, the machine provides a performance which is just about top of its class.
2. That most of the automated functions are well engineered, well executed and in the main, carefully thought out.
3. That the automatic selection of tape type without recourse to some over-ride function, is a disadvantage for people who do not own newly purchased tapes, or who own a series of previously well recorded tapes with either chromium dioxide or metal formulation.
4. The intro-play capability, the record-mute capability and the counter tape time capability are three functions which anybody (myself included) would welcome on a new cassette recorder and should be regarded as almost being a mandatory requirement.
5. The MS rewind/review capability is something that I do not think I would often use. But I do acknowledge it could be useful on many occasions when searching for a specific piece of recorded material on what is likely to be a poorly annotated pre-recorded cassette.
6. Last, but not least, the data operation indicator with the automated bias calibration equalisation and level setting function is a tremendous advance in automated electronics and is most probably the *piece-de-resistance* of this particular machine.

At a recommended retail price of \$749 this recorder constitutes excellent value for those hi-fi purists who, like me, are searching for a machine that does much more than the average cassette recorder and provides performance to match.

SAVE 20% THIS MONTH SAVE 20% THIS MONTH

TRANSFORMER AND PLUG PACKS

TAKE 20% OFF ALL THESE PRICES THIS MONTH ONLY

OFFER EXPIRES
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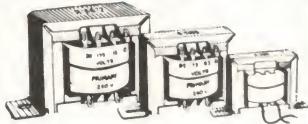
ECONOMY IMPORTED MODELS



1-9 10+
M12155 Trans
240V 6-15V 1A
tapped \$5.95 \$4.95



M12156 Trans
240V 6-15V 2A
Tapped \$7.95 \$6.95



M12851 Trans
240V 12.6V CT
150MA \$3.95 \$2.95



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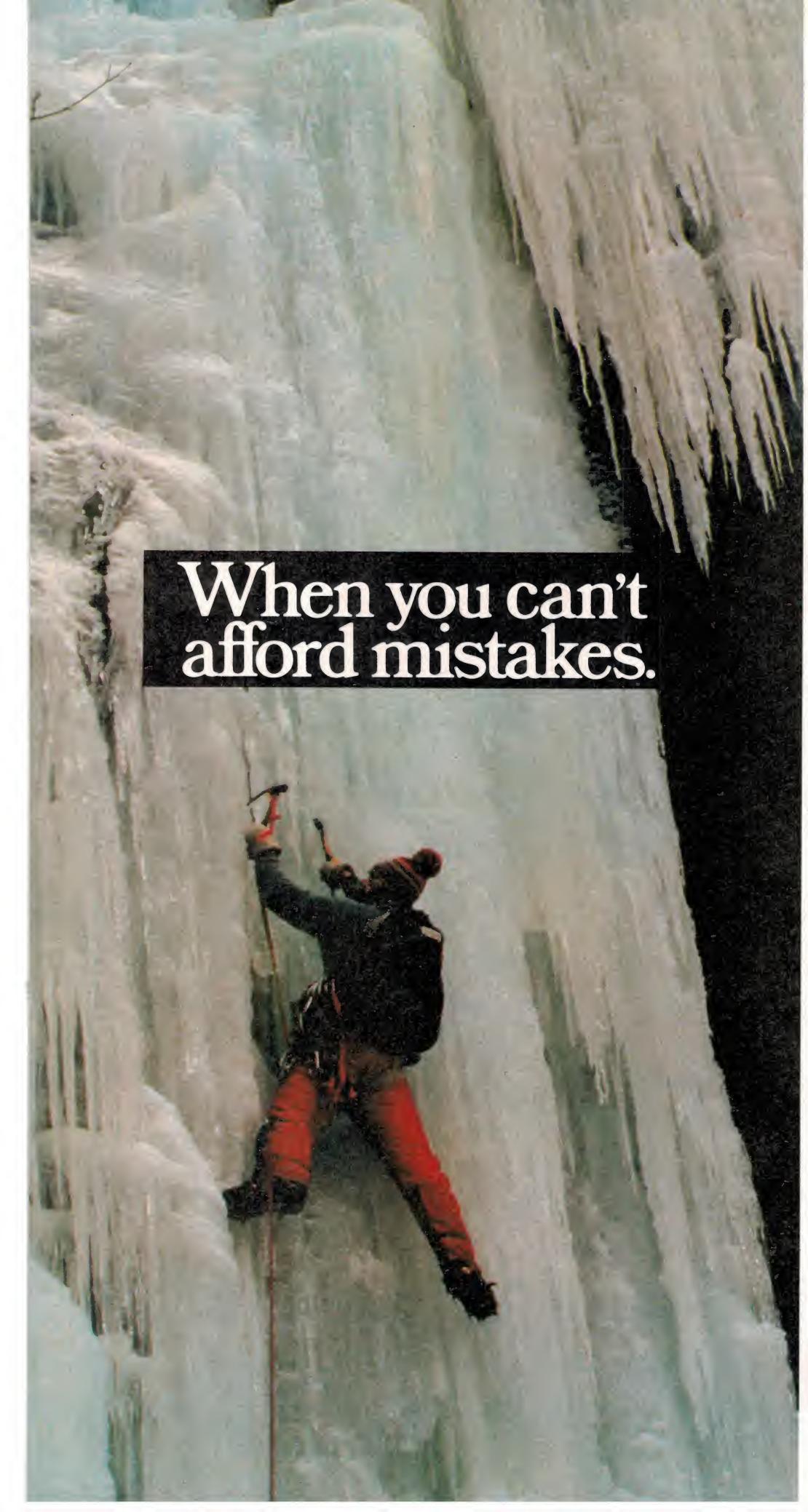
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A black and white photograph of a climber in a red and black jacket and red pants, using ice axes and a rope to ascend a steep, frozen waterfall. The background is a dark, textured rock face.

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The Nashua logo, which consists of a stylized 'N' shape formed by three concentric circles of different colors (red, yellow, and blue).

There really is a difference.



Cat challenges mouse, claims granny Smith

Dick Smith has just released its long-awaited Apple-compatible personal computer, the Cat. They claim the Cat will sell in Australia for many hundreds of dollars less than comparable PCs like the Microbee and Apple 11c.

The Cat is based around the 6502A CPU, as used in the Apple. It comes with 32K of ROM and a genuine memory-mapped screen. In addition, the Cat offers as standard a parallel printer interface, 80-column text, a full keyboard with eight function keys, and a numeric keypad. There is a joystick port and an RGB output port.

The Cat is manufactured in Hong Kong by Video Technology (makers of Dick's VZ-200) and shipped to Australia direct by DSE. It uses two VLSI maxi chips to avoid the legal problems currently being

encountered by manufacturers with Apple compatible computers. According to DSE, the Cat will run all the Apple software currently available.

The launch of the Cat has coincided with an increased emphasis on computing by DSE. Within the next few months a series of 'computer city' areas will be created within Dick Smith stores across the country.

These will be laid out on the familiar department store lines of the existing shops, but will have qualified sales staff for advice and after-sales back-up, the company says.

NEW LIFE FOR CHIP-8 LANGUAGE

TWO RECENT RELEASES, one for the Microbee and one for Tandy's MC-10 Colour Computer, promise to inject a new lease of life into the CHIP-8 language.

CHIP-8 is a simple beginners' language. Originally developed by RCA for their eight-chip 'trainer' micro, the VIP system VP-111 and adapted to kit computers such as the ETI-660 Learners' Micro and Michael Bauer's 'Dream'.

It uses around 30 simple mnemonic commands which are easy to learn and use. It is a video-oriented language, runs faster than most other high level languages and is simpler to learn than machine code. It is ideal for games and graphics manipulation, although screen resolution is limited.

Melbourne-based software producer, Dreamcards, has just released a ROM-based version of CHIP-8 for the Microbee. It features enhanced facilities that take advantage of the Microbee's PCG graphics and can be conveniently embedded in Microworld BASIC REM statements. The new CHIP-8 interpreter gives you 112 cursors which can be loaded with data to set up a hi-res pattern. The number of cursors available make for very sophisticated graphics.

You also get alphanumerics with one simple instruction plus an autorepeat facility. In addition, there are "half tone" cursors which can be mixed on-screen with any number of hi-res cursors and alphanumerics. A wide range of sound effects is possible, rivalling many hardware sound units, Dreamcards claim. You get two joystick commands, too.

On top of all that, the 'Bee CHIP-8 incorporates extended maths and I/O functions, page addressing, an execution rate control and an instruction that writes binary data to an imaginary CHIP-8 screen memory aid for converting programs designed for other computers. It all comes with a well-written and very comprehensive manual. Details from Dreamcards, 8 Highland Court, Eltham North Vic 3095. (03)439-4467 (a.h.)

CHIP-8 for the popular and inexpensive Tandy MC-10 Colour Computer will shortly be available from the 'Dream' originator, Michael Bauer. Our information indicates the language will be extended to support the full 128 x 96 pixel four-colour graphics of the MC-10. Further details from M. J. Bauer, P.O. Box 221, Ivanhoe Vic. 3079.

Sex changes



A Melbourne Company has released a locally made cable-end sex changer for RS 232 data communication links.

The Red Box Gender Mender is available as a double male or double female, wired-through pin to pin. It comes complete with two sets of male, and exclusive anti-rotation female, screw

locks.

The Gender Mender can be quickly fitted to any cable or panel situation, changing the sex of the connector and providing the required retaining facility.

For more information contact Kent Design, P.O. Box 325, Malvern Vic 3144. (03)509-8751.

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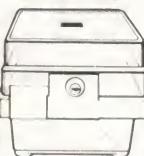
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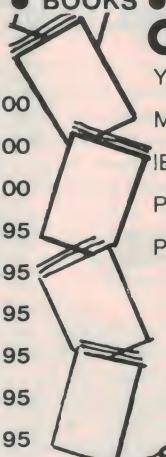
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Mighty mouse

The emerging dominance of IBM in the microcomputer industry has spawned a huge market for add-on equipment designed to improve the performance and expand the capabilities of IBM micros as sold in their original configurations.

But all is not roses for add-on equipment suppliers. IBM, streamlined and free of the fetters imposed on it for so long by the now-dropped Justice Department antitrust suit, is playing Mr Nice Guy to no one.

The new IBM stands ready and willing to do battle for any and all markets, including the ones created by its own micro-

computers.

IBM is likely to counter the add-on equipment suppliers in two ways. First, it is likely to turn more and more to bundling add-on equipment into original offering configurations. By 1994 fully one-third of all potential IBM add-on equipment sales will be pre-empted by bundling.

The second way is by direct head-to-head competition. Here, IBM will have the enormous advantage of its name and reputation. By 1994, IBM is expected to have 85% of the communications board add-on market, 70% of the memory board market, 50% of the add-

on storage equipment market and 40% of add-on display device sales.

The input device known as the mouse gives a particularly dramatic example of how IBM's presence will affect competitors' sales. The mouse is going to be the surprise winner of the '80s, thanks to increased demand for windowing, for which the mouse is ideally suited.

Although only 25 000 mice were sold as add-on devices for IBM micros in 1983, the number will climb to 100 000 in 1984 and to an astonishing two million by 1989, with the accompanying generation of \$300 million in

revenues.

But the bottom will fall out of the mice market after that. By 1994, sales of add-on mice will be down to the 500 000 level. The reason: IBM's bundling of mice into the original offering configuration. Of the total of 7.5 million IBM PC-compatible mouse sales in 1994 fully 7 million will be bundled by IBM. And mouse manufacturers, having expanded production mightily in the heady '80s, will wake to find themselves caught in a mouse trap of IBM's making, while Big Blue walks off with the cheese.

Program copyright

The Australian Computer Retailers Association (ACRA) welcomes the announcement that legislation will be introduced to amend the Copyright Act to include computer software in the definition of 'literary works'.

ACRA is pleased that ownership of software will be formalised in law, because had such recognition not been given, the improvement of existing software and the creation of new software would have almost ceased in Australia. Without the potential for monetary reward, personal recognition and satisfaction, there would be no incentive for programmers.

The association has urged that the computer industry, the Federal Government and international bodies will need to draft totally new legislation to define man's intellectual relationship with computers.

Insurance for hackers

Owners of electronic equipment and small computers will find it very simple to purchase inexpensive cover with New Zealand Insurance. This is because the company has broken with tradition, and owners will no longer always be required to hold a maintenance

agreement for the equipment being insured.

The new 'electronicsurance' package will cover electronic equipment up to a value of \$75 000 a unit and computers up to \$40 000 a unit. The extensive coverage includes loss or damage caused by accident and negligence, theft, electrical breakdown, mechanical breakdown, water damage, lightning, earthquakes, data reconstruction costs (up to \$5000) and increased operating costs (up to \$10 000).

The policy also provides for replacement of damaged equipment with new equipment when less than five years old.

For further information contact Ray Cooksley of NZ Insurance, 20 Bond St, Sydney NSW 2000. (02)232-0122.

Computer Patch

Does your computer installation look like a birds nest? If it does, you might be interested in the Australian-made matrix patch panel. The panel is wall mounted and so avoids unsightly cabling. It provides an aesthetically pleasing monitoring display in computer and communication rooms.

The panel has horizontal slots (each slot represents a computer input) and vertical lines (representing the peripheral outputs, i.e. 16 slots by 16 lines, or, 16 computer inputs to 16 peripheral outputs. Each panel comes with

16 patch pins. Wherever a patch pin is inserted, it joins a computer input to a peripheral output.

The patch pin can be supplied with certain additional options, such as monitoring LEDs; colour coded tabs for line identification, security protection and VDU monitoring facilities.

By daisy chaining additional units a virtually unlimited number of lines can be switched. For more information contact Communiltron, 35-37 College Street, Gladesville NSW 2111. (02)896-1655.

Squeezing the competition

IBM is in the process of using its increasing dominance of the business computer market to secure its position in the large-company teleprocessing network business. According to a new research report from International Resource Development Inc, a US consulting firm, recent IBM announcements of the 3270-PC and XT-370 are reinforcing the suspicion among plug-compatible manufacturers of 3270-type terminals that IBM is in the process of implementing a product strategy which will make the large corporate users return to the IBM fold.

A key element of IBM's strategy is to implement a token-passing local network architecture to interlink 3270 terminals, personal computers and PABX systems. The initial

local network products, being developed by IBM under the code name 'Alligator' will be on the US market by mid-1984, according to the IRD report.

An offshoot of the IBM strategy will be to make the design of an efficient 3270/LAN/PABX hookup something of a spider's web of twisted-pair wiring, coaxial cable and black-box controllers. IBM salesmen and applications engineers will take advantage of this complexity to discourage customers from self-engineering their data communications and terminal networks. This in turn will make it more difficult for the plug-compatible 3270 vendors to learn of sales opportunities for their products, and increase the likelihood that the customer will buy all-IBM, rather than putting together mixed-vendor networks.

More than fifty companies offer terminals, protocol converters or other products for 3270 networks. Most of these products, according to IRD, are either directly plug-compatible with one or another of the IBM family of 3270 products or else, as in the case with protocol converters, provide compatibility to otherwise incompatible terminals. Continued growth is expected in the market, with the total installed base of 3270 terminals (IBM and compatibles) topping seven million in 1990, compared with three million today. However, the market environment for the plug-compatible vendors is expected to be difficult, as the impact of IBM's new network architectures is felt.



Tasman Printer Interfaces

A small Tasmanian company has just released news of new Spectrum interfaces. The Tasman interfaces allow the Sinclair Spectrum computer to be used with any printer using either the Centronics or RS-232 standard connections.

The interfaces come with driving software which allows all normal characters plus special print styles, control characters and graphics to be utilized,

depending on the capability of the printer. Concise instructions for making optimum use of the interfaces are supplied with the units.

Tasman also produce a word processor for the Spectrum called Tasword 2.

For further information, contact the distributors **Dolphin Computers**, 99 Reserve Rd, Artarmon NSW 2064. (02)438-4933.

Tandy baby expansion

Did you know that Tandy's new MC-10 baby colour computer, which sells for less than \$100 on special, is based on Motorola's 6803 (enhanced 6800)?

Coupled with a suitable expansion board, it makes an ideal starter system for hobbyists, or a second (perhaps dedicated) system for seasoned

micro users.

An expansion board is now available which accommodates a mixture of RAM and EPROM devices (6116, 6264, 2716 thru 27128), up to 36K in total, plus a 6821 PIA for control applications. A short form kit comprising a double-sided pc board, buss edge connector and documentation is priced at \$40 (incl.

post within Aust.).

Future offerings will include a machine code monitor and CHIP-8 language EPROM, which will support the MC-10's 128 x 96 pixel colour graphics mode (not accessible from BASIC).

Please write for details to **M. J. Bauer, P.O. Box 221, Ivanhoe Vic 3079.**

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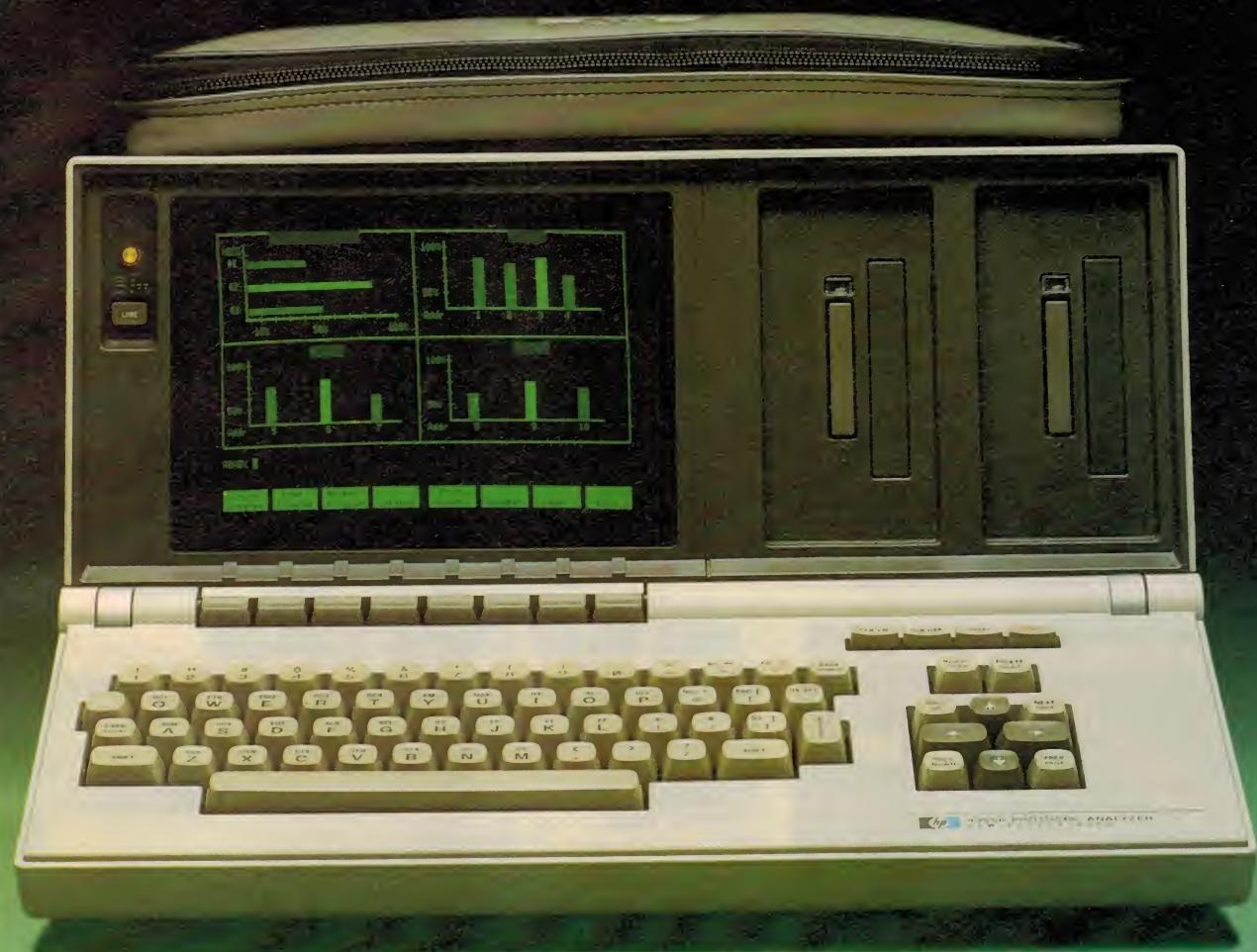
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Noise: -116 dB below full output (flat, 20 kHz bandwidth).

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SPECIFICATIONS

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 Phono: 52 db 50K STEREO x 2 (2mV) at 1KHz
 Effect Return (Aux): 20 db 50K x 1
 GCF (PTT): 20 db 10K
 Level Impedance L & R: 20 db 2K
 Effect Send 0 db 2K F/B Out 0 db 2K
 Headphone Stereo +10 db 600 (100 1K)
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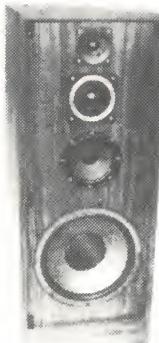


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NetComm has released its wholly Australian designed and built multi-function modem for Apple computers.

The modem is the first in a range of modem products and

one of very few with proper Auto Dial, Auto Answer and Auto Disconnect facilities. It offers Apple computer users a true multi-function capability.

The unit may be pre-set with a series of hardware switches but may then re-configured under

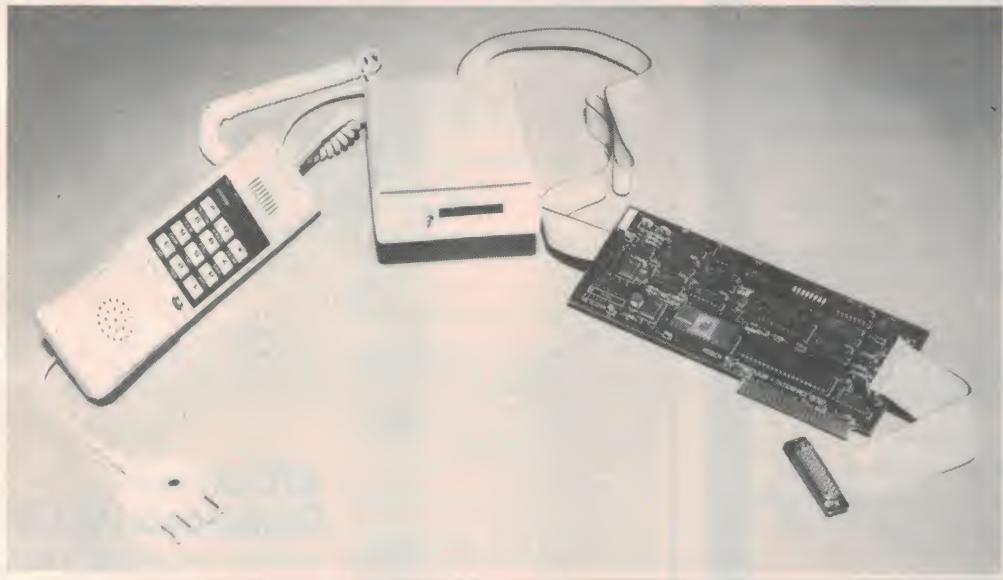
program control. This means the modem may be used to connect the Apple to virtually any remote computer service.

The modem is controlled by an on-board microprocessor with in-built RAM and EPROM. The modem complies

fully with Australian CCITT standards but may be re-configured for use with the US Bell standards.

A Telecom approved slimline touch dial 'phone handset is supplied with the modem and can be used for voice conversations. Auto re-dial is built-in.

For more information contact Data NetComm, 33 Ryde Road, Pymble NSW 2073. (02)498-5577.



8/16-bit business computer

In a move to significantly expand the range of applications software available for its systems, Vector Graphic has introduced an 8/16-bit business computer capable of reading IBM-PC, PC XT and other soft sectored floppy disks.

The standard Vector 4-S includes a 16-bit CP/M-86 operating system, a CP/M simulator to run 8-bit CP/M-based soft-

ware packages, an 8-bit Microsoft BASIC interpreter, and other software development tools. GSX-86 graphics is included, generating monochrome graphics with up to 16 levels of grey. An optional Aydin Controls colour monitor produces sharp screen displays with up to 16 selectable colours; an optional flatbed plotter creates charts and graphs with up to 16 colours.

Vector Graphic describe the Vector 4-S as a complete information management system designed for use anywhere there is a need to gather, analyse, or manipulate information and to obtain printed reports, invoices, or statements.

For more information contact Dicker Data Projects Pty Ltd, 78 Captain Cook Dr, Caringbah NSW 2229. (02)525-2122.



Pc boards

Energy Control has just released news of a range of new circuit boards. Part number EC 545 is a colour RGB CRT controller based on the 6545A controller. EC 364 is a 64K EPROM module with an RM 65 compatible bus.

They also have a single board controller module, an intelligent peripheral controller and a high isolation interface I/O module.

The products are available together with their data sheets from the distributors, Energy Control, P.O. Box 6502 Goodna, Qld 4300. (07)288-2455.

Lynx eats mouse

Associated Controls has released a cursor controller that acts like the mouse, called the Lynx. The Lynx is a trackball, i.e. the user controls the movement of the cursor by rotating a ball mounted on a low profile stand.

The stand has three buttons that can be user defined, and communicates with the computer via an RS232 interface. Baud rates between 300 and 19 200 can be set.

For more information contact Energy Control, 55 Fairford Road, Padstow NSW 2211. (02)709-5700.

Tandy BASIC

Now available from Tandy are two new languages to update the capabilities of the TRS-80.

'OS 9 Disk Operating System' is a real time operating system that accesses the entire memory of their new extended colour computer.

'Basic 09' is a Pascal-like version of BASIC, with much faster execution times than conventional BASICs.

'OS 9 Disk Operating System' is available for \$99.90 while the 'Basic 09' costs \$149.50.

Contact Tandy for details at 91 Kurrajong Ave, Mt Druitt NSW 2770. (02)675-1222.

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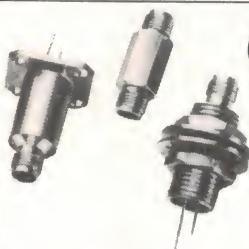
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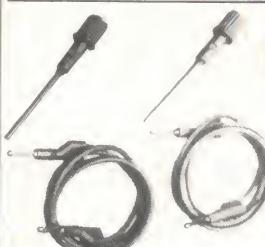
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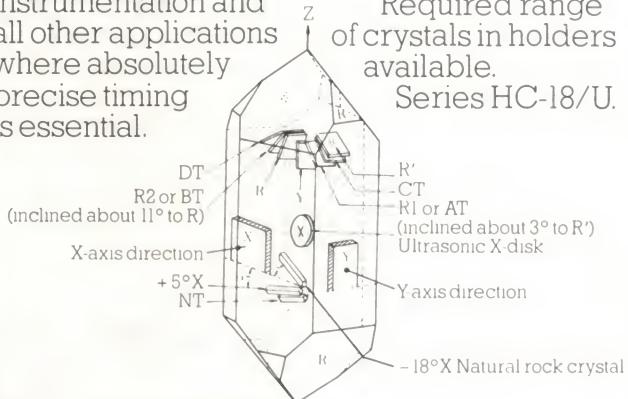
For further information and data sheets contact your local distributor.
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Ritron monitor

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Evan McHugh

THE RITRON MONITOR is 300 mm wide, 300 mm high and 300 mm deep. It is basically a box without legs, so it has no ability to tilt and swivel.

The monitor handles 80 characters by 25 lines with relative ease, although there is obvious separation of pixels on the vertical. Reverse video is legible but not pleasant, as the horizontals are much bigger than the verticals in the letters. This problem can be reduced by turning down the brightness. However, it also occurs frequently in other machines, even in ones that are in much higher price ranges.

The monitor has a vertical scan of 800 lines and a vertical resolution of 640 pixels. The screen is just under 300 mm across the diagonal.

The screen of the Ritron monitor is treated to reduce glare and reflections, so that the overall impression is matt. Two types of screen are available; the usual green screen costs \$179 and the amber screen is \$199. The recommended screen to go for is the amber, not just because it is the latest trendy idea, but because the eyestrain caused by prolonged use of a monitor does appear to be less with an amber screen — when used correctly.

The practice of turning the brightness up to full intensity will both increase the possibility of eyestrain and other physical problems, and probably 'burn' the screen in a very short time. Set the screen intensity to complement the ambient light level; it saves both your eyes and the screen.

Flicker is not noticeable. There is a small amount of slewing and curve at the edges of the display, but this can be reduced through adjustment.

The front panel of the screen is a low-glare grey plastic trim which gives a good contrast. At the front of the monitor, where it should be, is a flip-down door containing all controls — including ones often stuck somewhere inside the box or inaccessibly round the back. These adjust focus, horizontal width, horizontal hold, vertical size,



vertical linearity and vertical hold; there are also the usual brightness and contrast controls. With these controls you are able to adjust the size and shape of characters to a high degree.

The on/off switch is also located on the front panel, just beside the door to the adjustment controls. A red LED above the on/off switch indicates power status.

At the rear of the monitor are the video input and a video output sockets which allows parallel connection of monitors. Both are BNC sockets. The housing is metal with a grey trim.

Comments

In normal operation this machine is quite satisfactory. The screen looks good, and things happen quickly and smoothly. As such it is highly recommended as an all-purpose workhorse monitor.

However, we used it for quite a long period of time, and found a slight instability (possibly a one-off fault in the review unit), so it would be as well to check the clauses of the warranty pretty carefully before buying. A small amount of pressure on the top of the box caused the screen image to disappear. Also, just after turn-on, there was an occasional flicker of the screen as I banged away on the keyboard. Sensitive!

The suspicion I developed was that all was not perfectly well inside the box. To avoid the inconvenience of having it croak on you one day with no possibility of comeback, check your warranty — and perhaps the availability of service and replacement parts.

In spite of this quibble, the Ritron is a good monitor. If you are looking for a flicker-free, all-purpose monitor in this price range, it is well worth considering.

You can get the Ritron monitor from two Rod Irving Electronics stores: **Ritronics**, 425 High St, Northcote Vic. 3070, and **C-Tech**, 48-50 A'Beckett St, Melbourne Vic. 3000.

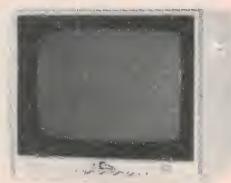
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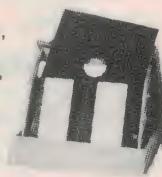


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A linguist's reply to Dr Koji Kobayashi

The interface between modern communications systems and human beings is a meeting of radically different 'minds' and languages. Dr Koji Kobayashi in his article on *Computers and Communications* (ETI, May '84) approached that interface as an expert on the machines and their capabilities. Known facts about the other side of the divide — human language systems and their mental backup — remain a closed book to most people, including alas, electronics and communications experts it seems?

Thor May

Department of Linguistics,
University of Newcastle, Newcastle NSW

DR KOBAYASHI has hinted that simultaneous translation between Japanese and English is just around the corner. Indeed, he is confident that his own corporation has the resources to put it all together. I am afraid somebody may be conning him. That is a harsh suggestion, but it wouldn't be the first time a magic translation machine has been flogged to an eager client.

In the early 1960s a group of American linguists had a wonderful scam going; it was in a good cause. They talked the Pentagon around to funding research into machine translation. The generals thought that instant translations of *Pravda* would be coming along in no time. It took them about a decade to realise that the product had a hundred year lead-time! While the party lasted some useful work was done, although a few of the researchers were as naive as their benefactors.

Look at reality

Let's look at the reality. The first daunting fact is that a machine which is able to provide proper translations between natural languages will, by any reasonable use of the word, no longer be merely a machine. It will be a sensing, feeling, thinking creature, capable of independent ideas and actions. In other words, it will have that baffling amalgam of experience and potential which we normally associate with the human mind. Anything less will render it incapable of interpreting the full significance, the meaning, of our subtle and shifting systems of signals.

Suppose that in an engineering sense the necessary stack of microchips can be jiggled together (always remembering, however, that the human central nervous system,

which is being emulated by our language machine, has a range of possible contacts amongst its cells which exceed the number of atoms in the known universe); then what sort of software design problem would the researchers really be faced with?

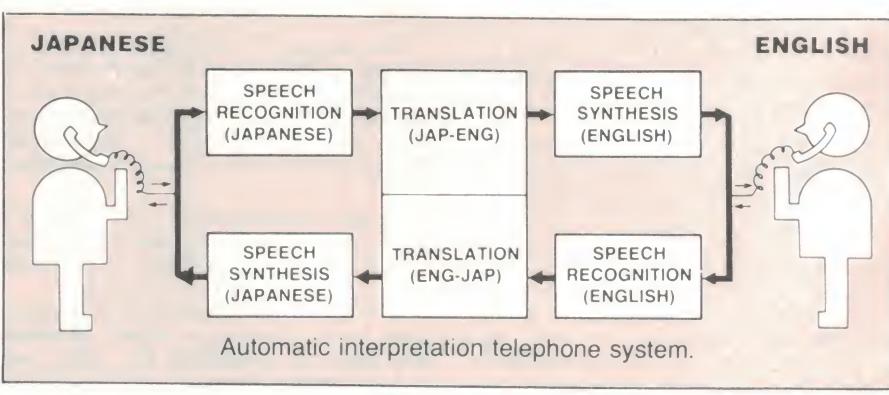
Well, first of all, they would have to understand the parameters of the systems they were trying to model; in this case, natural language systems and human knowledge systems. Surely there are people around who can provide that sort of information? Everyone knows a language. At least one. Any fool can learn to speak as a child.

Now this is the point, unfortunately, at which linguists and the rest of humanity cease to understand one another. You probably learned a few conscious rules of grammar at school. You may even have a word processing program which does a rough

check of your sentence structures, or one of those clever voice synthesisers for your home computer. You will, therefore, think me misguided or a charlatan to insist that at the current rate of research we are not within generations — human generations — of understanding the set of rules and constraints in any natural language (English, Japanese, you name it . . .) needed to write that marvellous computer program that will freely translate one language into another.

Phonology not the problem

The problem is not the sound systems (phonology). Sound vibration is only one possible medium for carrying language. Alphabet writing on paper is another, binary codes yet another. Within the brain the mediums are electrical and chemical. But language itself is an abstract thing, a maze of interlocking symbol systems. ►



COMPUTERS AND COMMUNICATIONS

We know that those systems are highly organised since you and I understand one another, more or less. But switching mediums freely as they do, and not being absolutely constrained by the laws of time and space, as the 'visible' systems of physics and biology are, language systems have evolved in unique ways to levels of complexity that have so far defied comprehensive analysis.

Language is a constant stage show for all the tricks of the mind, yet those of us watching have been unable to see behind even the simplest sleights of hand by that cosmic magician, our inner being. In fact, I am prepared to lay odds with Dr Kobayashi, or anybody else, that natural language will ultimately provide the greatest of all challenges in the universe to the ingenuity of human science.

Clocking the code

Fine minds, you might think, would compete for the glory of cracking those miraculous language codes. Well, they mostly haven't. Of course, there are other people doing related work in Artificial Intelligence, Neuro-Biology, Psychology, and so on. But like all the best mysteries, this one has been seen by few eyes. The disguise is brilliant because it hides behind that most familiar of things, our own voice. Worldwide there are, at the outside, a few thousand people doing any sustained work in some branch of theoretical linguistics. Most of them can't make a full living at it.

(The word 'linguist', by the way, is a bit like 'engineer'. There are many kinds of linguists, as different as civil engineers and garage mechanics. I am talking in this article about that very small group of scientists concerned with investigating the universal structures of natural language).

The vast majority of theoretical linguists would not claim any knowledge of, or even interest in, computer simulation. Their territory is the human mind, or abstract models thereof. There is no doubt, however, that their work will ultimately be turned to extra-human language production.

A very few large American corporations have employed or contracted a theoretical linguist or two as a long-term investment; (e.g.: Dr Paul Postal at IBM; Dr Joan Bresnan at Xerox). Rather more people have jobs as 'computational linguists' but their work, by and large, consists of finding clever ways to extract information from exponentially expanding data banks.

Japan, with a handful of honourable exceptions, has very, very little trained talent in the field of theoretical linguistics. Outside of Tokyo University (and perhaps Sophia University), there is scarcely a credible Department of Theoretical Linguistics in that country. That is, unless Dr Kobayashi has a tribe of linguists hidden in a cave on the Izu-Shoto (islands). The much vaunted fifth generation computers being developed in Japan are, it seems, likely to be pretty dumb after all!

On the rocks

Is the communications revolution going to shatter against the rock of natural language then? Yes and no. Things are not utterly hopeless. As many readers will know, elements of linguistic knowledge are already being successfully used in electronic products and communications procedures. Voice recognition is becoming more and more sophisticated. Computers, even now, can be taught to recognize and produce simple messages using elementary fragments of human grammars.

One would expect this process to continue and accelerate. There are even existing programs to provide 'rough' language translations between natural languages. They often produce absurd outcomes, but sometimes prove a useful prop for the memories and pen hands of overworked human translators. It is not surprising that non-specialists so readily make the quantum leap from these admirable achievements to the belief that Luke Skywalker's talking robot pal, C3PO, will turn up in the next Christmas stocking.

Professional linguists themselves have too often dismissed computers as being irrelevant and unusable for their present purposes. (Many were made sceptical by the Pentagon scam mentioned earlier). Solving the Universal Language Puzzle is rather like playing with a thousand-sided Rubik's cube. To keep track of all the 'coloured squares' is beyond the mental ability of any single player and friendly computers should certainly help your neighbourhood linguist to stay on the right side of sanity.

Consequences of a C3PO

Finally, it must be said that many of my colleagues would regard the prospect of a true language-using machine with the sort of trepidation that those scientists on the Manhattan Project knew a generation ago. They have a point. The consequences of a C3PO, when it finally arrives, will surely be more devastating than any atom bomb. Humanity will then have taken command of evolution. We will have created a creature equal to ourselves. Dr Kobayashi, you may be waiting a while for that instant Japanese-English telephone conversation.

Further reading

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Chomsky, N. (1976); *Reflections on Language*, Temple Smith.

Lyons, J. (1977); *Semantics*, Vols. 1 & 2, Cambridge University Press.

Michie, D. (1974); *On Machine Intelligence*, Edinburgh University Press.

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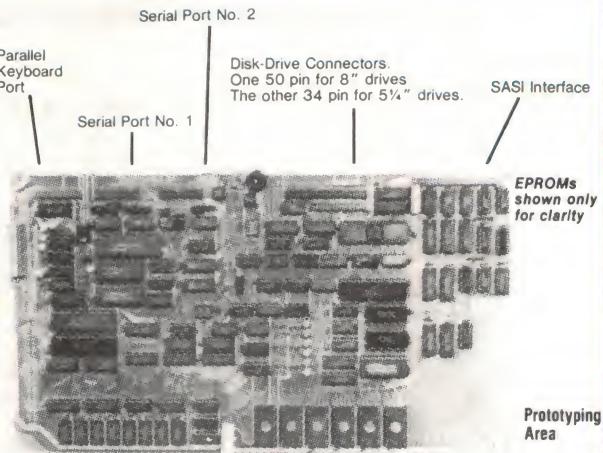
The new Ferguson SBC uses a 6845s CRT controller and 8002 Video Attributed controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5 x 7 dot matrix on 15.75 KHz monitors and 7x9 dot matrix on 15.75 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters.

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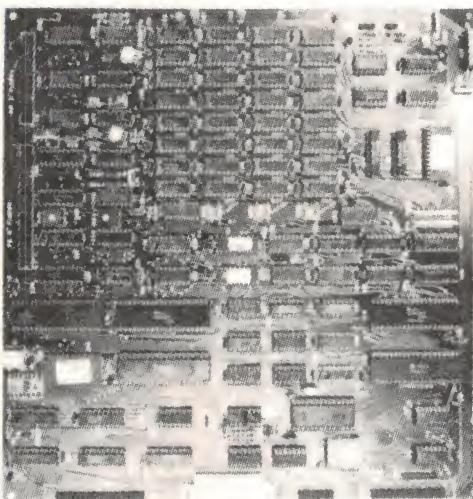
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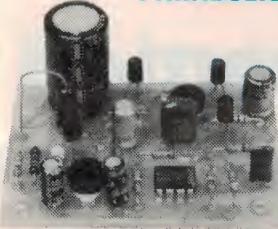
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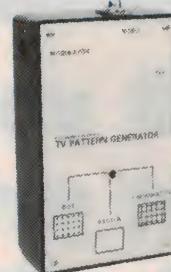


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ELECTRIC FENCE
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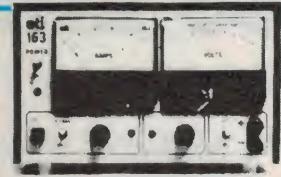
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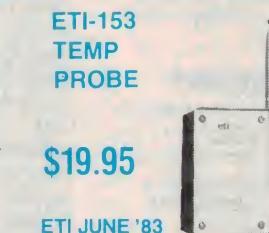
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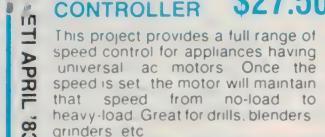


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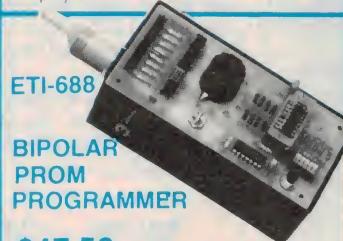
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Printers: All you ever wanted to know about printers, but were too afraid to ASCII

Jon Fairall

In the second of an occasional series of consumer articles for the electronics enthusiast, Jon Fairall looks at the printer market, what's happening, where it's going and how to buy one.

THERE COMES a time in the life of every computer buff when he or she starts writing programs that won't fit onto a video screen. Troubleshooting is a nightmare of scrolling back and forth looking for the problem. Or maybe, you would dearly love to use your computer as a typewriter and send letters that people can actually read. Are you just a frustrated author who will never begin that great novel until you have a wordprocessor in the study?

If any or all of this applies to you, then you need a printer.

So, how to buy one? The problem is that printers are not simple machines. In their own way they are as complex as the computers that drive them. The market place is also complicated with brand-names and printer types competing for your attention in bewildering profusion. And of course, the bottom line is that there is also a bewildering array of prices.

The good news about the bottom line is that it dropped through the floor during 1983! Just one year ago a printer was an expensive add-on to the average home system. Now it is possible to buy a very rea-

sonable quality printer for the same order of price as the micro itself. Certainly, for less than \$1000 you can buy a printer that will give you quality indistinguishable from a high quality office typewriter. If your priorities are different you can have high quality colour graphics, or maybe briefcase portability and battery operation.

A POTTED HISTORY

Printers as an add-on to the micro computer were developed in rough parallel with the micros themselves. During the 1960s they began to appear in increasing numbers. In 1968 the Shinshu Seiki Corporation in Japan began marketing the EP101, a small, light unit that was immediately successful with the home market. By 1975 Seiki was preparing to market a successor to the EP101 and, at the same time, were looking for a new name for their printer division. So the son of EP was produced by Epson, and no doubt a lot of money was made by all concerned.

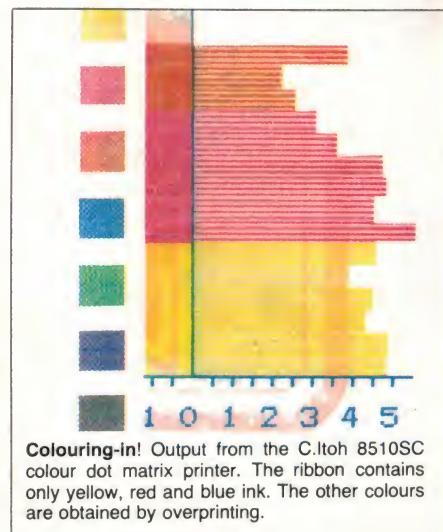
Predictably, it wasn't long before someone else tried to muscle in on the act. The main competition came from the Shinwa Corporation. Shinwa's marketing strategy

has been to allow its distributors to put their own name on the printer, with the result that what at first sight appears to be a bewildering profusion of types turns out to be identical printers with slightly different control panels and very different prices! The Admate DP80, the CP80, the Fax80, the Amust 80DT are all identical machines boxed-up to look slightly different. Even the manuals are the same once you get past page one.

Whether this is fair to the consumer is a question we can put to one side, because whatever the morals of the situation might be, the results of the competition for the consumer have been breathtaking.

As you can see from the table on p.60, prices for all these printers are at rock bottom, even where there is a fair degree of variation in them. Even some of the proprietary labels are getting in on this act. Commodore's latest offering, the 1526, for instance, employs an identical printing mechanism to the xx-80 type machines but has customised buffering and interfacing inside to make it compatible with the Commodore computers and their software.

There have been other price pressures on the market as well. All these printers are dot matrix types (more about the different types later). But during the last year daisy-wheels have come on the market that sell for prices very close to that of the dot matrix types. So the dot matrix distributors have cut prices even further. There are also some



Colouring-in! Output from the C.Itoh 8510SC colour dot matrix printer. The ribbon contains only yellow, red and blue ink. The other colours are obtained by overprinting.

COLOUR — THE WAY OF THE FUTURE

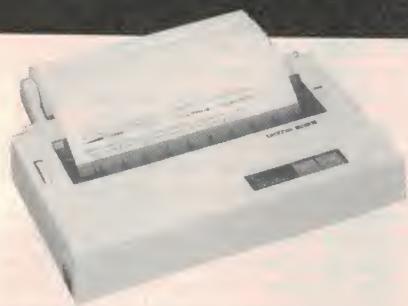
One of the most promising developments in the printer market is the development of colour printers. They add a whole new dimension to the use of printers for graphics. They have tremendous value in business applications because of their ability to put out colourful, and thus easily assimilated, graphs and diagrams. There is also an enormous market waiting for cheap colour machines, composed of people who just want to have fun with them at home.

At present the cheapest way of getting into colour is via printer/plotters. These suffer from the limitations mentioned in the main text, but they do offer impressive graphics capacity at a very reasonable price. Colour is obtained by using a number of pens, either stored on the side of the board, as in the Roland machines, or slotted into a rotatable drum as in the Toyo models. These pens are selected as required.

Another method, albeit considerably more expensive, is to adapt a Dot Matrix printer, as

C.Itoh have done. These machines, distributed by Warburton Franki in Sydney, are standard Matrix printers except that they have a colour ribbon on their head. The carriage has been adapted so that it can move up and down under software control to bring the different colours under the needles. There are three colours on the ribbon: blue, red and yellow. A whole spectrum of colours can be created by overprinting each line. Printing a line first in yellow, then in red yields orange, for instance. As can be seen from the print sample from the C.Itoh 8510SC the method works surprisingly well, although there is a slight register problem. (Register refers to the ability of a multi-run printing system to overprint in exactly the right position).

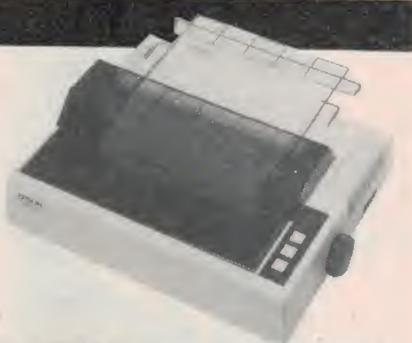
The third alternative is the colour inkjet. This is a brand new development, so new in fact, that despite our best efforts we couldn't get hold of one for this survey. They are being distributed by Anderson Digital Electronics for around \$800 and promise breathtaking graphics capabilities. ADE expect to begin marketing later in the year.



Brother HR-5. A tiny 303x175x65 mm ac/dc machine with thermal or dot matrix options.



Silver-Reid EXP 500. A solid daisywheel printer.



Epson RX 80. The baby of the Epson Range. It offers high quality design with respectable printing at a reasonable cost.



H-P Thinkjet. It comes in a little square box that hides some really advanced features.



EP-44. A revolutionary typewriter from Brother with a display that shows the last 15 characters as they are typed. It also has a Centronics socket on the side so it functions as a printer. The keyboard would not please a professional typist but it is excellent for a 'peek and poke' merchant. Print quality is disappointing given the other advanced features.

Figure 1. A daisywheel printing system. The hammer is immediately in front of the arrow. The daisy itself is clearly visible in its perspex tray.



new technologies appearing on the market that have significant advantages in terms of noise and speed. One of these is the inkjet, which Hewlett Packard has just introduced.

The net result of all of this has been to squeeze the thermal printers, which used to be the cheapest, almost into non-existence. Now, it is possible to pick up small thermals for less than \$200. Admittedly, they are only small format machines, but they are quite adequate for program listings where only 40 columns are required.

THE TYPES OF PRINTER

Broadly speaking, there are three types of printer available: those that make a mark with a solid hammer, called a font, those that do it by making a pattern of dots, called a matrix and printer/plotters, which use a pen to draw the letters.

Daisywheels

Conventional typewriters fall into the first category, but the system of cranks and levers they usually employ is far to slow and cumbersome for electronic control. The solution favoured for printers is called the *daisywheel* (See Figure 1). In this system a spoked wheel, called a 'daisy', carries the pattern of each individual letter on the end of its spokes. Printing is enabled by rotating the wheel until the appropriate spoke is underneath the hammer. When the hammer fires it drives the spoke forward, thus putting the impression of the letter onto the paper via an inked ribbon.

The resulting printer is usually not particularly fast, and always very noisy, but it has the great advantage of producing beautiful type, as you will see from the print samples in the table. The shape of the printed character (i.e. the font) can be changed by changing the daisywheel.

Printer typewriters

A sub-group of the daisywheel printers is composed of the printer typewriters. Essentially these are daisywheel (or sometimes thermal) printers with a typewriter keyboard on them. They can be operated in either printer or typewriter mode at the flick of a switch. Generally there is a buffer between the typewriter and the printer, the contents of which can be viewed on a display contained on the machine.

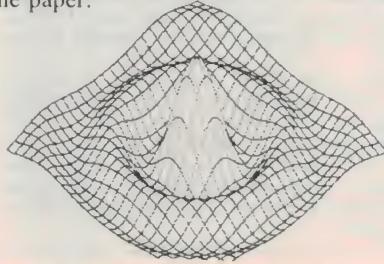
Matrix Printers

These printers can be subdivided into a number of categories. For a start, there are the dot matrix types. In these, there is a print head that travels up and down the platen. On the head is a column of small needles. To print, a needle is fired forward by an electromagnet. The needle hits an inked ribbon and squeezes it up against the paper, thus creating a tiny dot. The firing of the needles is controlled by a character generator chip in the printer, which, upon reception of the appropriate code from the

host computer generates the correct sequence of needle firings to put a recognisable character on the paper.

In virtually all dot matrix printers it is possible to override the functions of the character generator and control the firing of the needles individually from the host computer. This is known as graphics mode.

In the graphics mode the printer interprets the data being sent to it as a binary control code for the individual needles. Thus, if the printer receives 8F(hex), i.e: 10001111, it will fire the first, fifth, sixth, seventh and eighth needles as it passes over the designated position. Using this mode it is possible to have total control over the appearance of the page. It can be used to produce whatever graphics you may wish, or a screen dump, in which the entire contents of the video screen are printed onto the paper.

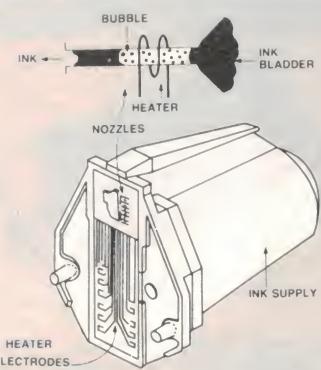


All a plot! Dot graphics example from the Dick Smith BX-80. Typical of the output from the Shinwa-type machines operating in the bit graphics mode. (Thanks to Peter Bauer from DSE Broadway.)

Thermal Printers

A second type of matrix printer is the thermal type. Thermal printers utilise the heat sensitive qualities of specially treated paper. When a point on the paper is raised to a certain band of temperatures it will not burn, but discolours in a predictable fashion. A common type on the market for instance, turns black when exposed to a temperature of about 165 degrees C.

The thermal printer's head contains a vertical row of heating elements that travel very close to the paper as the head moves across the platen. When one of these elements is subject to a pulse of current it heats up, exposes the paper to its heat, and leaves behind a small dot. Thus, it functions exactly like the dot matrix type, except that, since there is no impact mechanism there is no noise.



Fire! Ink cartridge from the H-P Thinkjet.

INKJETS

The inkjet is the latest refinement in the story of dot matrix printers aimed at the home user. A number of the biggest companies, including Canon and H-P, are in the process of bringing them onto the market during 1984. They are claimed by their manufacturers to have significant advantages in terms of speed and noise over conventional dot matrix types of a similar price.

While details of Canon's version are still sketchy, the H-P version is available now. The inking system itself consists of a small cartridge that drops into a slot in the laterally moving head. The cartridge consists of a rubber bladder filled with ink, a heating mechanism and a column of 11 nozzles. Ink is drawn into the nozzle by capillary action. When required, the ink waiting in the nozzle is vapourised by a tiny heater wrapped around it. The vapourised ink forms a bubble which expands rapidly, driving a precisely controlled quantity of ink out of the nozzle, and onto the page. As the bubble collapses the nozzle refills with more ink from the bladder and is again ready for use. As the ink is used up the bladder collapses, providing constant pressure on the ink.

H-P claim some remarkable performance specifications from the machine, including 150 cps, and almost totally silent operation. Indeed speed is going to be one of the big selling points of inkjets as they try to take some share of the market. Canon claim that their inkjet will be able to complete printing of an A4 page in just six seconds.

Inkjet types

A variation on this theme is the inkjet printer (see box). This is the most modern answer to the continuing quest for speed, silence and flexibility in printers. The first inkjet to be marketed in Australia for under \$1000 was launched earlier this year by Hewlett Packard as the 'Thinkjet'. Canon has one that should be available here by the end of the year, and small quantities of a colour model are already available from Anderson Digital for around \$800.

Even further down the track is the laser printer. Laser printers have been available to commercial users for quite a while, but Canon hope to be able to release a small unit for domestic use later on this year. It will be called the LBP-CX.

Printer/plotters

The third major type of printer is the printer/plotter. Plotters are devices that are used for making line drawings under processor control. Printer/plotters are a development of this idea in which a character generator is fitted to the unit, making it possible to generate the full range of ASCII characters. As you can see from the print sample from the Toyo TP-40 sold by Dick Smith, the result is quite acceptable letter quality printing. In fact, watching the TP-40 in action is to watch servo motor control of very high order, as both the pen-head and the platen have to be moved together to create the characters. The only problem with this particular unit is its small size, which restricts its use in the text mode.

INTERFACING

Interfacing, or connecting, your printer to your computer ought to be a matter of taking your printer home and plugging it in. Often it is, but as we found when doing this survey, in a surprising number of situations it is not that simple. One would expect that there would be a single standard to which all computers and all printers would conform. Such is not the case however. There are at least two major types of interface and a host of variations to them.

Even so, it should be possible to buy off-the-shelf interfaces to fit most situations. The Alphacom printers manage to do this with a series of neat little boxes that plug into the back of the machine and make it compatible with most computers.

The reasons for this state of affairs appear to be lost in the mists of history. Some manufacturers no doubt have a tradition of doing things in a certain way, and see no reason to change things. Others see the standards as limiting their ability to offer a greater diversity of functions. And of course there is always the question of commercial advantage.

But the situation is not one of complete anarchy. In general, there are two types of interface, either serial or parallel. With a parallel interface, data from the computer data bus is fed, via a buffer, to an output port. The buffer functions to prevent any peripheral device, like a printer, from loading the bus and so interfering with the normal housekeeping functions within the computer.

The buffer has eight output lines, plus a few control lines, which are connected via a ribbon cable to the input port of the printer. Beyond the input port there is another buffer which does a similar job for the printer.

A serial interface is a far more complex system all together. The buffer here also functions as a parallel to serial converter, i.e.: it takes the parallel data from the bus and converts it into a string of bits which it sends down a line one at a time. The buffer must also generate stop and start pulses to allow the printer to recognise the beginning and end of each byte.

The parallel interfaces seem to offer the least trouble. The industry standard is called the Centronics interface, and it specifies a set of TTL logic conditions for the transmission of data from the host computer to its peripherals. Apart from the eight data signals which appear on pins two to six, there is also a strobe signal on pin 1 which indicates to the printer when it should read the data. There is an acknowledge signal on pin 10 and a busy signal on pin 11. Pin 16 contains the chassis ground, and pins 17 to 30 the logic ground. The remaining pins, up to number 36 are concerned with minor housekeeping matters.

The serial interface is by no means as simple. The industry standard is called the RS 232. The problem with it is that every manufacturer seems to have his own interpretation of RS 232. So voltage levels vary and the functions available on individual pins vary.

All is not lost however. Many of the minor problems that come up with RS 232 interfaces are well understood, and printer manufacturers offer the option of changing various parameters of the interface with the aid of DIP switches, usually located inside the print head compartment, or else on the back of the cabinet. To understand what these are, it is necessary to understand a little about the problems of transferring data in serial mode.

When you do things in the parallel mode, the one control signal that is really vital is the strobe, which tells the printer when the combination of bits on the input is valid. In



Interfacing. One solution to interfacing. The boxes contain an Intel 8049 processor programmed to carry out the conversion from the computer's protocols to something the printer can handle. The printer here is an Alphacom Midi. (From Oscwell International.)

When is 180 CPS faster than 200 CPS?

When you have this little beauty on hand. **Throughput speed** is what counts: C.Itoh's new low profile dot matrix printer is a high speed performer, prints out with a throughput of 100 LPM (draft mode with pica character).

You'd expect to lose visual quality? No way! C.Itoh's print resolution is sharp, defined, unbeatable — throughout the print head's 100 million-plus character life.

8510S is rugged, sturdy as it is fast, built to take the punishment with heavy duty castings and high quality metal parts throughout. Plastic parts are all high stress.

It's a colourful character: there's even a colour model which gives you up to seven colours, with high resolution graphics of 144 x 160 dots per square inch on all models.

And if you want to use all the features

of your IBM personal computer, C.Itoh has two special versions designed just for the IBM PC.

So make sure you ask the **throughput** of your new printer. And take a close look at C.Itoh. It answers all the questions.

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Name	Distributor	r.r.p	Measured speed (cps)	Measured loudness (dB)	Print matrix	max columns	comments
THERMAL PRINTERS							
Alphacom Pony	Oscwell	\$190	20	<20	7 x 5	40	ultra small and quiet printer
Alphacom Middi	Oscwell	\$290	32	33	7 x 6	80	
Brother HR5	Brother	\$299	27	<20	9 x 9	80	Available with a.c./d.c. supply
Star stx-80	Case Communications	\$358	22	<20	5 x 9	80	
DOT MATRIX PRINTERS							
Commodore MPS 801	Commodore	\$399	30	34	6 x 7	78	Only compatible with Commodore machines
C.Itoh M8510S	Warburton-Franki	\$1139	80	40	9 x 9	132	Colour version available
Epson RX 80	Epson Australia	\$558	89	28	9 x 9	137	Wide version available
Star Gemini	Case Communications	539	33	35	9 x 9	136	Wide version available
WP 1100	NSA	\$559	34	36	9 x 11	80	
Shinwa Dot Matrix Types							
Admate DP 80	Applied Technology	\$399	32	34	7 x 6	142	
Amust 80DT	SAE	\$299	"	"	"	"	
BX80	Dick Smith	399	"	"	"	"	
CP 80	Rod Irving	399	"	"	"	"	
1526	Commodore	\$499	"	"	"	"	
FAX 80	Electrical Equipment	\$414	"	"	"	"	
DAISYWHEELS							
HR-15	Brother	\$849	23	33	N/A	165	Typewriter keyboard available
Juki 6100	Rod Irving	\$995	10	34	N/A	220	
Silver Reid EXP 500	Pacesetter Peripherals	\$880	13	32	N/A	151	" # \$ %
Uchida	Electrical Equipment	\$660	10	31	N/A	180	
PRINTER/TYPEWRITERS							
EP-44	Brother	\$399	—	<20	24 x 18	80	Thermal head
INKJET PRINTERS							
HP 2225	Hewlett-Packard	\$795	—	<20	11 x 12	80	
PRINTER/PLOTTERS							
Toyo TP-40	Dick Smith	\$299	4	<20	N/A	80 -	GHJKL

Special prices on these printers are readily available, especially from mail order houses. Shop around!

48 PRINT#4, "*** NORMAL UPPER CASE";CHR

BIT-MAP GRAPHICS ALLOWS YOU TO PRINT 620 DOTS OVER THE 80 CHARACTER LINE

20 LPRINT CHR\$(27); "L"; CHR\$(160);

"#\$%&' ()*+, -./0123456789:; <=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[£] ^_`abcdefghijklmnopqrstuvwxyz

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uvwxyz The Quick Brown Fox

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The Quick Brown Fox Jumped Over The Lazy Fat Lazy Dog.

, -./0123456789:; <=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[£] ^_`abcdefghijklmnopqrstuvwxyz

+, -./0123456789:; <=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[£] ^_`abcdefghijklmnopqrstuvwxyz

way to test this is to type into it the words that one would normally use

These dot matrix utility printers use HP's disposable ink jet printhead

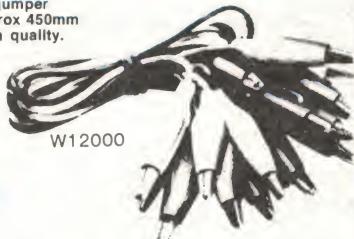
BNMqwertyu wertyu lop lkjhgfdsaz gfdaszxvbnmSQWERTY QWERTYUIOPASDFGHJKL

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JUMPER LEADS

Set of 10 jumper leads approx 450mm long. High quality.

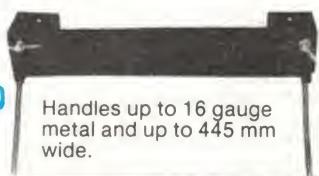


\$4.95

Sheetmetal Bender

T12400

How often have you wished that you could afford a Pan Brake Bender. Well this unit is a close second for your workshop. Your own chassis, boxes, brackets, are all possible with the unique slotted clamping bar that allows complex corner bends.



\$79.50

Handles up to 16 gauge metal and up to 445 mm wide.

Tapered Reamer

T12370

Great for enlarging holes that are a bit too small. Enlarges from 5-20mm.

\$6.95

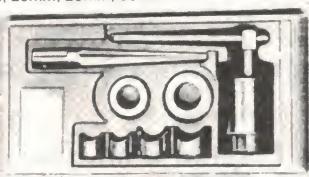


Chassis Punch

T12360

Absolutely essential for an enthusiast, prototyping technician or serviceman. Cuts holes in metal up to 16 gauge or 1.6mm. Essential for building kits. Punch Sizes: 16mm, 18mm, 20mm, 25mm, 30mm.

\$18.95



6000 RPM Mini Drill 12V DC (Drill Bits)

MINI DRILL T12302

.6mm T12319
.8mm T12320
.9mm T12324
1.0mm T12325

ALL \$1.50



\$14.95

12V DC operated great for PC work. 1.2mm check capacity. Comes complete with 1mm Drill Bit.

Pearl Catch

T12380

Dropped something in an odd spot? This Pearl Catch is what you need to get it out. Great for picking up small screws, pins, nuts, washers, resistors, etc. Also can be used for holding items in place.

\$3.95



TWEEZERS



Needle Nose T12375 1-9 \$1.20 10+ .90

Duck Bill T12377 1-9 \$1.20 10+ .90

Jewellers Screwdriver

T12200

\$4.95



Needle File Set

T12350

An indispensable part of your tool kit designed especially for electronic work or areas where a precise finished job is needed. Lasts for years.

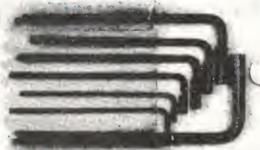
This set contains 5 files: Flat, Half Round, Triangular, Square, and Round.

\$9.95



Allen Keys Set

T11410



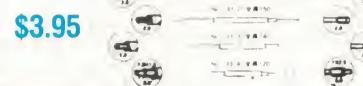
\$2.50

Alignment Tool Set

T11400

Ever tried to adjust an IF can or coil using the wrong sort of tool or filed down knitting needles then breaking the slug.

This set of tools will pay for themselves many times over, both in time and stopping you obtaining ulcers.



\$3.95

Pin Vice

T12352

It's infuriating when all you need to do is drill one hole a little bit bigger and haven't got a drill that fits in your tool box. Buy one of these for drilling circuit boards, will hold drill bits, taps, files, etc. up to 3mm.

\$7.95



OFFSET SCREWDRIVER

Flat blade one end with Philips at the other. Ideal for those hard to get at screws.



\$2.95



Wire Stripper

T11520



\$9.95

Alignment Screwdriver

T11401 T11402

Spring steel tip plastic shaft is absolutely essential for alignment work around E.H.T. or other high voltages.

\$1.50



Steel Rule 300mm

T12382

\$3.50

Neon Test Screwdriver

T12222

Neon lights up to tell you if voltages are present over 90 volts (AC DC) essential for people working on mains circuits who know how a power point or extension cord is wired.



\$1.50

Hand Nibbler

T12355

Easily operated hand NIBBLER cuts any shape hole in sheet steel—aluminium—copper—or plastic. Metal remains flat and straight after cutting. Does not add strain or distortion to edges. Cuts holes in preformed sheet metal (air-ducts, chassis, etc.) without distorting original form. Cuts in all directions.

Any design—angle—radius. Follows scribe lines easily. Best possible tool for cutting template and model parts from thin metal.



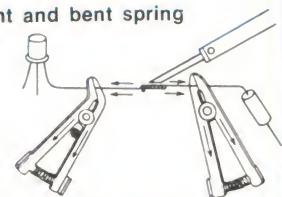
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HEAT STOPPERS

A set of straight and bent spring loaded clamps

T12440

\$3.50



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SAVE 10% SAVE 10%

HEAVY DUTY DIAGONAL CUTTERS AND WIRE STRIPPERS

\$7.95



Jaws line up perfectly and will not twist or distort through use. The sharp cutting edges have two small holes. One is 1.2mm (0.05") and the other is 1.6mm (0.06"). Finish: Chrome plated with plastic insulated handles.

MICRO NIPPER

115mm

For delicate and intricate high precision electronic works. Polished head with insulated handle.

T12050

\$9.95

MICRO ROUND NOSE PLIERS 115mm IN LENGTH

Smooth jaws are round and tapered to a fine point (1.5mm x 3.5mm). It can provide excellent precision work result.

\$8.95

T12075

STUBBY SCREWDRIVERS 83mm IN LENGTH



PRICE

T12110 FLAT BLADE 1.40 1.20

T12115 PHILIPS HEAD 1.40 1.20

NARROW FLAT BLADE (2.6mm BLADE)



PRICE

T12125 BLADE LENGTH 100mm .55 .50

T12130 BLADE LENGTH 20mm .65 .55

SURGICAL TYPE CLAMP

All stainless steel made. Box joints for added durability. 125mm long. Has to position snap — lock. Excellent heat sink and clamp. Allows quick disconnect and reconnect for temporary connections.



\$9.95

MICRO LONG NOSE CUTTING PLIER

T12060

\$8.95

Very fine point for delicate work in very confined areas.

Size: 125mm (5")

Finish: Polished head with plastic insulated handle with spring.

FLAT NOSE PLIER

T12001

\$7.95

Tip top of jaws are slender and flat. For repairing precise instruments, measurement apparatus, etc.

Finish: Plastic insulated handles.

Size: 115mm (4 1/2"), Polished head. (A) 0.9 x (B) 0.8mm

T11302



UNIVERSAL SOLDERING IRON STAND

1.9 1.0+
\$5.95 \$4.95

PHILIPS SCREWDRIVERS

BLADE SIZE	BLADE LENGTH	OVERALL LENGTH	PRICE
T12170 00	75mm	130mm	.60 .50
T12175 0	100mm	175mm	.90 .80
T12180 1	125mm	210mm	1.20 1.00
T12182 3	150mm	256mm	1.75 1.40

MEDIUM DUTY FLAT BLADE (4.5mm BLADE)

BLADE LENGTH	PRICE
75mm	.70 .60
150mm	.80 .60

FULLY ADJUSTABLE MAGNIFYING GLASS

Flexible arm magnifier best suited for your desk, bench or machine. Ground and polished 90mm glass lens in metal frame with ball joint and flexible arm, which can be angled in any direction. Length of flexible shaft: 190mm. Power: 2.2X

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TRANSISTOR NIPPER

T12070

\$7.95

Specially designed for cutting copper wire in small gauge and for delicate and intricate high precision works in electronics. The width of joint portion is 3/8" (10mm). Confidently recommended for assembling and repairing transistor radios, TV, Printed Circuit Boards, etc. Finish: Polished head with plastic insulated handles.

HEAVY DUTY SIDE CUTTING PLIERS

T12045

\$16.95

25mm JAWS
150mm LENGTH

Regular edge

SOLDER

We carry a wide range of sizes and rolls of solder, as one size is not sufficient for every type of soldering job. (All are resin cored, Aust. made, 60/40 5 core solder.)

CAT NO	SIZE	ROLL WEIGHT	PRICE
T31000	.71mm	250gm	\$8.95 \$7.95
T31002	.71mm	500gm	\$14.95 \$13.00
T31010	.91mm	250gm	\$7.95 \$6.95
T31012	.91mm	500gm	\$13.95 \$12.50
T31020	1.6mm	250gm	\$6.95 \$5.95
T31022	1.6mm	500gm	\$12.95 \$11.95

MINIATURE SCREWDRIVERS

Unobtrusive keep one in your top pocket. Great for screw on items like record players (needles and cartridges)

T12100 FLAT BLADE	PRICE
1.6mm x 55mm O/A LENGTH	.50 .40

T12102 MINIATIURE PHII IPS	PRICE
	.60 .50

HEAVY DUTY SCREWDRIVERS

T12150	BLADE LENGTH	OVERALL LENGTH
T12155	6.0mm BLADE	125mm
T12156	8.0mm BLADE	200mm
		160mm 215mm 305mm
	PRICES	1.9 10+ 1.40 1.20
T12150		1.65 1.40
T12155		2.00 1.75

PRECISION SCISSORS

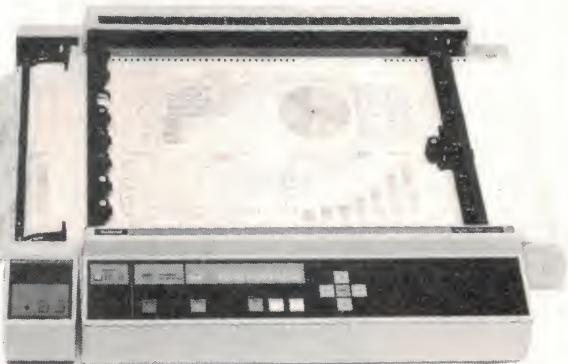
Made from stainless steel for delicate work and non-slip cutting.

T12080	PRICE
	\$7.95

8 PEN MULTI COLOR PLOTTER

at an affordable price

NEW



National A-3 Type Digital Plotter
VP 6802A

1. MULTICOLOR HIGH SPEED PLOTTING

EIGHT COLOR GRAPHICS AT 450mm/sec (18 inch/sec)

The high plotting speed of 450mm/sec (18 inch/sec), the variety of pens (fibre, ball point, plastic tip) and colors allows great versatility in the creation of graphs.

2. SIMPLE PROGRAMMING

A VARIETY OF INTELLIGENT FUNCTIONS

The high level of intelligence built into this Digital Plotter greatly simplifies the programming required to generate the complicated engineering drawings or business charts.

3. RELIABLE PAPER SECURITY

ELECTROSTATIC PAPER HOLDING

The highly reliable, electrostatic paper-holding method guarantees secure paper holding, which is applied by simple switch operation.



4. QUIET MOVEMENT AND SAFETY

DESIGN CONSIDERATION ON MECHANICAL CONSTRUCTION AND SOFTWARE PLUS PROTECTIVE COVER

The detachable plastic cover assures durability and safety while suppressing the movement noise substantially.

5. CONTINUOUS PLOTTING

AUTOMATIC CHART ADVANCE "OPTION"

By combining the automatic chart advance option, this plotter can function in a totally unattended mode. This makes it possible to build up fully automatic drawing system which does not need any human care.

6. COMPUTER INTERFACES

THREE TYPES

Eight bit parallel, RS-232-C and GP-IB interfaces are able with VP-6802A. The above interfaces allow the plotter to be used as a computer graphics device as well as an instrumentation graphics device.

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CICADA 300 Baud DATA MODEMS



- CICADA 300
- CICADA 300T with telephone
- CICADA 300 for use with Commodore 64 and Vic 20 computers



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Dealer enquires welcome.

the serial mode this type of function is not necessary, but a number of other protocols are. For a start the printer must know how many bits constitute a word. This is usually a switch selectable function, with one side of the switch being seven, the other eight.

It must also know which of these bits to read as data. Many systems employ the first or least significant bit as a parity check, in which case it must not be read as part of the data. Parity checking is a system in which either the high or low signals are made to have either an even or odd number, depending on the system used. A system is said to have even parity if it requires that there be an even number of ones (or zeros) and odd parity if there should be an odd number.

Unfortunately, RS 232 does not specify the method of parity checking, and since, in fact, it is of very little use in small scale systems operating in low noise environments, many manufacturers have decided to do without parity checking altogether.

The result of all this is that there can be three dimensions for error to occur in parity checking. It can be that there is a mismatch in the type of parity, i.e. even instead of odd parity. There can be an error in terms of the logic level, i.e. high instead of low, and there may be a mismatch inasmuch as one or the other of the elements in the system may expect parity checking when none occurs.

Clearly it is necessary to specify the voltage level at which all of this occurs. The specification requires that Centronics all be

at TTL levels, i.e. 5 V, while the RS 232 should be held at plus or minus twelve volts, with plus or minus three volts being indeterminate. However this doesn't always happen. Sometimes this type of problem is introduced deliberately by a manufacturer in order to force the user to make the 'correct' purchase decision. Commodore is a case in point. Their computers have an RS 232 compatible output, but with voltage levels of 5 volts. There are no prizes at all for guessing who makes printers with 5 volt RS 232 inputs!

Another thing to bear in mind when checking for compatibility is the speed of data transmission. This is referred to as the baud rate and it must be the same for both machines. One baud equals one character per second. In general this is a switch selectable function with 300 baud and 1200 baud as the most common options on small systems.

If the manuals are available most of these problems can be sorted out in fairly short order, by either resetting the switches inside the printer or rewiring the cable that comes with it. If none of this will make the beast run, there are a number of things you can do. One is to go back where you bought the thing and say "help" in a very loud voice. Another is to read some of the articles that have appeared in ETI over the years on curing interface problems. Most of the common faults can be found in the article "Beating the RS 232 blues" (August 1982) or the article on the RS 232 troubleshooter that appeared in the following edition.

PRINTERS

WHICH IS BEST

As is often the case with surveys of this kind, it is impossible to give a unique answer to this question. The decision depends on individual needs and an assessment of the advantages and disadvantages of each type of machine. In our survey we assumed an absolute maximum limit of \$1000 in price, which should include most of the printers that would be used by the home or small business consumer. A brief look at the table and reading the above description of the different printers will show you at once that some types do some things better than others.

The first decision a prospective user must make is the prospective use. Do you want to be able to type office quality letters, do graphics, program listing or what? When you have thought about this a list of priorities will emerge that should allow you to start asking intelligent questions. If your primary requirement is for general document printing, for instance in a small office, then you will need a daisywheel, unless the slow throughout is a problem. If it is, then you may like to look at some of the more expensive dot matrix printers, or maybe some of the more exotic technologies, like the inkjets. These all put out quite presentable print but at considerably faster speeds. Dot matrix types are perfectly adequate for memos and inter-office correspondence.

MPF-III Apple IIe compatible

EMTEK EX-80



Printer Bargain

- 80 characters sec
- Dot matrix
- Bit image graphics
- Bi-directional
- Single sheet or continuous Tractor Feed
- Centronics parallel: interface (serial interface optional)
- Graphics

\$290*

Print Types

- + Enlarged
- + Italic
- + Compressed
- + Underlining
- + Double strike
- + Sub script
- + Superscript

FULL RANGE OF COMPUTERS AND PERIPHERALS SAVE \$\$\$

AGC HM-123



**GREEN
\$154***

**AMBER
\$156***

- 360° Swivel display
- Super high resolution
- Crisp 80 chr display
- Non-reflective screen
- Resolution: 1000 lines
- 22 MHz band width
- F C C Class B approved
- Attractive styling

EMTEK-PC™ 16 bit IBM compatible

SAKATA SP 1000



\$399*

For the office the Sakata SP-1000 offers 100 CPS speed as well as the features below to make your office application more efficient.

- Clearly formed dot matrix characters — 9-11 dots
- 12 variations of character printing within the same line including graphic printing
- Paper cutting edge 2cm from printing position
- Print-on fanfold, single sheet and roll paper
- Back feeding of paper
- Bi-directional printing
- Operator replaceable print head (no special tools required)
- Longer ribbon life (2.5 million characters)
- Centronics parallel and RS-232C Serial interfaces both included



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welcome here

PRINTERS

Beware of taking the manufacturer's word for the speed at which various printers print. There are two measures that can be used here. One is the speed at which the printer actually prints the characters. The other is the speed at which it can put material through, i.e.: it includes the time taken for carriage return and line feeds. Manufacturers quote their speed in terms of characters per second (cps), and for the Shinwa type machines you will find quoted figures in the region of 80 cps quite common. If you look at our table you will find our measured figures are considerably slower. The difference is a measure of the difference between throughput and cps. The measured figures are not nearly as impressive as the quoted specifications, but since you are probably more interested in how long it will take to print a document *in toto* rather than how fast it will print the individual letters, the latter is probably a more valid measure.

On the other hand, you might be only marginally interested in print quality or speed. It may be that the biggest requirement you have is for troubleshooting programs that are too long to be adequately handled on a video terminal. In these circumstances a 40 column thermal is ideal, or maybe you would wish to stretch your pocket just a little and go for a Shinwa type

dot matrix printer. This is certainly a very popular choice, since it gives passable letter quality and very flexible graphics characteristics at a reasonable price.

If your primary requirement is graphics then printer/plotters must be a viable option. They possess the disadvantage of low flexibility in as much as they cannot be used with anything but the correct format paper. On the other hand, their graphics capacities are far in excess of anything available for comparable prices and they have colour capability.

Paper handling

Another point worth considering is the arrangements that have been made for paper handling. There are two main types: tractor feed and friction feed. Tractor feed uses the familiar computer paper with the sprocket holes down the side. These fit into sprocketed wheels that usually sit in a little assembly above and behind the unit. The advantage of tractor feed is that it is possible to buy the correct forms in long chains called fan-folded paper. Friction feed is the type that is used in typewriters in which the paper is squeezed between some rollers, and fed through in single sheets. 'Sheet feeders' are available that do away with the necessity of hand inserting paper sheet-by-sheet when printing out multiple copies of documents.

In general the friction feed is harder to operate than the tractor feed, but it is indispensable if you are writing letters and don't want to use computer paper. However,

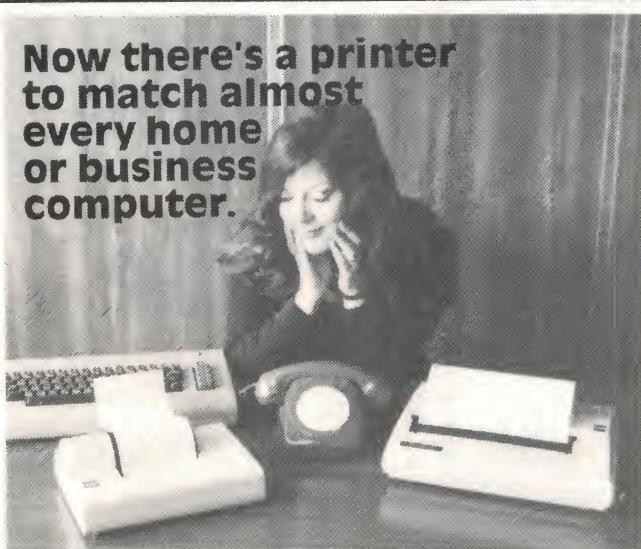
tractor feed paper with 'clean tearing' perforations is available. Once the sheets are separated and the sprocket strips removed, it's difficult to tell apart from ordinary paper sheets.

Whichever way you go, the paper requirements are just one of a number of on-going costs you need to be aware of. There is the cost of ink, for instance. A wide variety of inking systems are used in printers. The IBM type, in which the ribbon is packaged in a non-reusable cartridge, is one of the most common. There are countless variations on this theme, and very little standardisation, so every time you need a replacement you will need to go back to the original distributor. Some of the machines we looked at used old-fashioned typewriter ribbons, which get away from these problems, but only at the cost of your ink-stained fingers. You can do away with ink altogether, of course, and go thermal, but then you must pay for the special paper.

In the longer run there are more significant expenses. Thermal print heads, for instance, suffer from the stresses inherent in any system that involves an operating pattern of rapid heating and cooling. The needles in dot matrix heads are another problem area. Under stressful operating conditions they can seize up inside their shafts. These are expensive conditions you can expect every five years or so.

When you buy a product as complex as a printer, it is advisable to give some thought to peripheral areas such as the operating manual and after-sales service. The manuals

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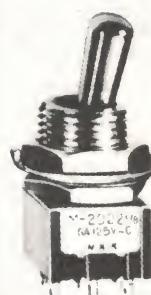
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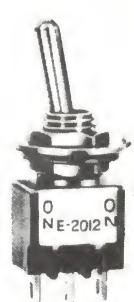
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**FLOPPY DRIVE
UPDATE**

U.S. FLOPPY MANUFACTURERS SIGN 3½" ACCORD

Micro Peripherals Incorporated have signed with U.S. east coast start-up, **Tabor**, to manufacture their 3½" 1 **Megabyte** microfloppy, thus making them the third supporter of this standard.

Incidentally, the drive dimensions match those of the miniature 25 **Megabyte** winchesters soon to be released by **Miniscribe**.

Disk manufacturers, **Dysan**, **3M** and **Brown Disk** are manufacturing the soft jacket media and claim considerable cost advantages over their rivals. The product is designated 320 series and will be in Australia in June, 1984.

CHINON SHIPPING 3½" FLOPPY DRIVES

Not to be left out of the standards race, **Chinon** Industries, manufacturers of both 5¼" drives and the HMM standard 3" drives, are now volume producing a 250 **KByte** single sided drive to take the **Sony 3½"** disk made popular by **Hewlett-Packard**, **Apple** and **ACT Apricot**. Unit prices will be around \$170 plus tax.

Later this year **Chinon** will release their 1 **Megabyte** version for sale to Australia. **Verbatim** have announced their manufacturing plans for 3½" media.

3.2 MEGABYTES ON A 5¼" DISK?

"No Worries"! says **MPI**. Their **Model 1722**, recently released, packs 3.2 **Megabytes** onto the new standard high capacity disk. Head alignment is done through a servo system which ensures high speed track access with excellent data retrieval quality.

Destined to become a universally accepted back-up medium for the new half height 5¼" winchesters from **Miniscribe**, the **1722** requires only three disks to off-load a full 10 Megabytes of data.

Priced at around \$500, the Model 1722 uses the same controller needed for 8" drives and is very competitive with tape back-up costing up to three times as much.

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we obtained with the printers were almost all poor. Some were just plain terrible. Many were written in Honda English of greater or lesser degrees of incomprehensibility. Those that we could understand seemed to assume that the user already knew how to operate the machine and that all that was necessary was a listing of a few commands. It is interesting to speculate how many people have bought printers and only use them to 1/10th their potential simply because they can't understand the manual. The outstanding exception is this depressing area was the Commodore manual, which gave a clear, concise explanation of how to operate the printer.

Since it is unlikely that this situation will change in the near future the relationship you develop with the supplier of your unit is important. It is a good idea to ask questions and to have a good idea of what you are doing before you leave the shop. In this context you might give some thought to the fact that some of the best deals around are from mail order places like Micro-Educational of Newcastle or SAE systems, who manage to do fantastic deals, particularly on the Shinwa machines, but whose after sale back-up is about as remote as their office. If you're an electronics or computing background and are prepared to do your own interfacing and servicing or maintenance, you can take advantage of great savings. If you're a computer neophyte, take the conservative route. It's the oldest story in the book: You pays yer money, and yer takes yer chance!

Distributor List

1. **Anderson Digital Equipment.** 9 Pioneer Avenue, Thornleigh NSW 2120. (02)848-8533. Distributors of the soon-to-be-released colour inkjet printers.
2. **Applied Technology.** 1A Patterson Ave, Waltara NSW 2077. (02)487-2711. Makers of the Microbee computer. They import the Admate DP-80 printer specifically for the Microbee.
3. **Brother Industries.** 49 Herbert Street, Artarmon NSW 2064. (02)439-7344. Brother produces a wide range of electrical goods, including sewing machines and some innovative printers.
4. **Case Communications.** 3 Rodborough Rd, Frenchs Forest NSW 2086. (02)451-6655. Distributors of Star printers in Australia.
5. **Canon Australia.** 37 Waterloo Rd, North Ryde NSW 2113. (02) 887-0166. Distributors of many electrical products including, in the near future, a low cost laser printer.
6. **Commodore Australia.** 5 Orion Road, Lane Cove NSW 2066. (02)427-4888. Distributes printers as peripherals to its other devices.
7. **Dick Smith.** P.O. Box 321, North Ryde NSW 2113. (02) 888-3200. Sells the Toyo TP-40 printer/plotter, the BX 80 and other printers.
8. **Epson Australia.** 17 Rodorough Rd, Frenchs Forest NSW 2086. (02)452-5222. Distributors of a wide range of printers for domestic and commercial users. Epson is the US subsidiary of Shinshu Seiki Corporation of Japan.
9. **Electrical Equipment.** 456 Kent St, Sydney 2000. (02) 290-2155. Distributes a Shinwa machine called the FAX 80 as well as daisywheels.
10. **Hewlett-Packard Australia.** 31 Joseph St, Blackburn Vic. 3130. (03)895-2895. Makes a large number of hard copy printout systems that can be readily interfaced to other brands.
11. **Micro Educational.** 17 Park Road, Garden Suburb Newcastle NSW 2288. (049)43-6805. A mail order company offering impressive discounts on some types of printers.
12. **NSA.** 200 Pacific Highway, Crows Nest NSW 2065. (02)923-1522. Distributors for Copal and Shinko printers, among others. NSA is part of the Hitachi group.
13. **Oscwell International.** P.O. Box 443, Gladesville. (02)816-3311. Distributor in Australia and New Zealand of Alphacom thermal printers.
14. **Pacesetter Peripherals.** 28 Chandon Streets, St Leonards NSW 2065. (02)439-4655. Distributors of Silver-Reid printers.
15. **Polykit Electronics.** 202 High Street, Northcote Vic. 3070. (03)481-7052. Distributors of the CP 80 and Juki 6100 printers. Retails as Rod Irving Electronics and C-Tech.
16. **Roland Corporation.** 23 Cross Street, Brookvale NSW 2100. (02)938-3911. Makers of a wide range of printer/plotters for the domestic and commercial markets. Its DXY 101 and 800 models will be of particular interest to domestic consumers.
17. **SAE Systems.** P.O. Box 402, Zillmere Qld 4034. (07)263-4762. A mail order house offering particularly good deals on computer related gear.
18. **Warburton Frankl.** 199 Parramatta Road, Auburn NSW 2144. (02)648-1711. Distributors of C.Itoh printers.

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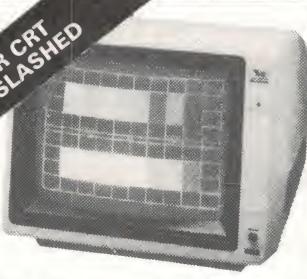
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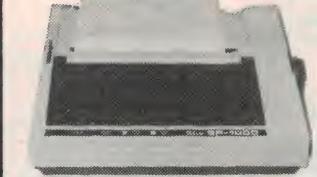


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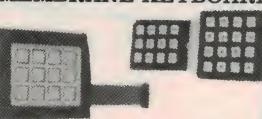
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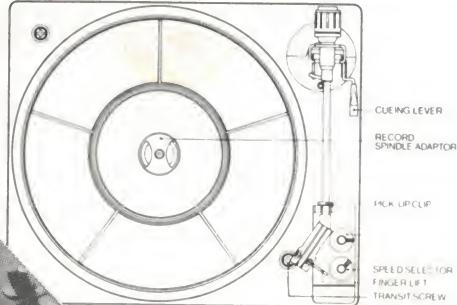
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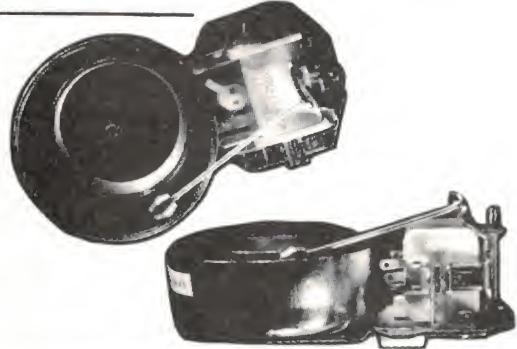
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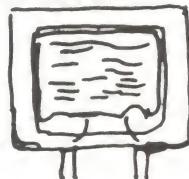
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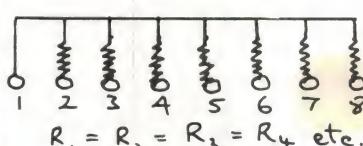
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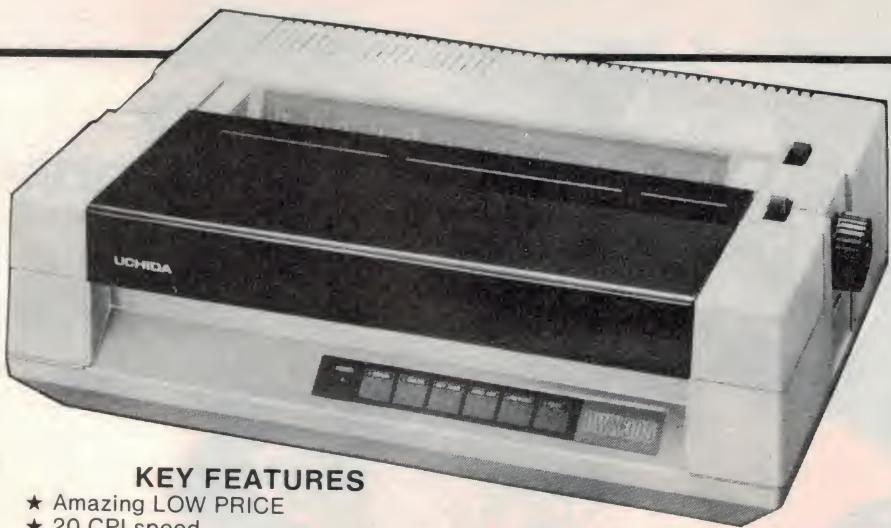
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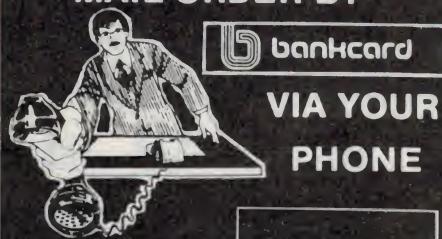
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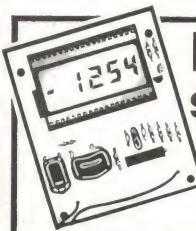
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PANEL DISCUSSIONS

Due to the vast differences of perspective in PROLOG, its theoretical foundation in mathematics and logic, and its relative youth and lack of development, this article will have several panels like this one. The panels will illustrate points, compare implementations and list ramifications; in fact, anything that is not absolutely necessary in the text.

The intention is to do more than just teach and illustrate the language, but to convey the unique characteristics which are essential to writing the 'real' PROLOG.

The panels are for the reader who is not interested merely in an overview of the language, but who wishes to gain a deeper understanding of it.

The suggested approach to the PROLOG articles is this. Read the text through fairly swiftly, spending time on the examples and making sure you understand them. Look at the cat.1

panels as you come across them. They will give you some background to what you are about to read, while providing a respite from the onslaught of definitions and allowing time for them to sink in. Then, to learn the language thoroughly, reread the lot and do the exercises provided.

HISTORICAL BACKGROUND

Alain Colmerauer, of the Artificial Intelligence Group at the University of Marseilles, France, had been working on a system of rewriting rules to be used in the production of grammars for their English/French translation program. He then became more interested in the process of deduction in the context of the semantics of French. He collaborated on the definition of a programming language capable of expressing these deductive attributes of language.

The language is PROLOG, and it took off immediately in quite a few diverse applications, including robotics, speech recognition and symbolic differentiation and integration. Two other researchers immediately saw the potential for the language and became its pioneers. I am referring to David Warren at the University of Edinburgh, and Robert Kowalski at the University of London.

The appearance of the original PROLOG is a far cry from the syntax used here. Although this syntax is now fairly universal, there are a multitude of variations — as discussed in the panel 'Current Implementations'. The background extends through the mathematical axioms of predicate calculus and first order logic, the logic techniques of resolution thereon proving, and the assertion and proof emphases of modern software engineering discipline — as can be seen in the panel 'Not a Programming Language'.

The applications and implementations have exploded in scope and ambition. The language has taken Europe by storm, is well established in Australian tertiary institutions, and is now sweeping the United States. The teaching of the language has progressed from a mere alternative to LISP in Honours level Artificial Intelligence courses to the second computing language taught in various Australian computer science curricula. It has also become the introduction to computers in certain overseas primary schools.

PROLOG

— programming in logic

PROLOG is more like automatic programming, or program proving, than programming in the conventional sense. It expresses relationships and goals, rather than algorithms or procedures, and has applications in artificial intelligence, pattern recognition and data bases. This article introduces you to the standard syntax and semantics of PROLOG.

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FOR EXPERIENCED PROGRAMMERS
it may, in fact, take a lot of unlearning to learn PROLOG. The transfer from Fortran to Algol, or from BASIC to Pascal, does not involve as fundamentally great a change of perspective, or thought or style; in a sense PROLOG is more advanced than these earlier 'new directions' in computing.

For inexperienced programmers it is easy to learn and absorb the essential ideas of PROLOG. The transfer required is from your understanding of the goal as expressed in words, to the expression in a 'logical shorthand' of the relationships involved; PROLOG expresses relationships and goals, rather than algorithms and procedures.

PROLOG is not a programming language. It is more accurately a specification language, and the PROLOG system automatically seeks to find a solution meeting your specifications.

The simplest place to start with PROLOG is in the storage, representation and querying of a simple database.

Facts — the unit clause

Suppose we want to represent a simple library catalogue and show the author and publication date of various works. Let us say that each entry is to have three pieces of information — author, date and title — in this order. We can then represent a catalogue entry in PROLOG by: entry ('Charles Dickens', 1859, "A Tale of Two Cities").

The process of storing our catalogue goes something like this. ':' is the system prompt which is printed whenever PROLOG is expecting input. 'cat.1' is a label added to the printout to allow reference to the example in the text — it is 'catalogue example 1'.

```
cat.1
: entry("Jonathan Swift", 1704, "A Tale of A Tub").
: entry("Jonathan Swift", 1726, "Gullivers Travels").
: entry("Daniel Defoe", 1719, "Robinson Crusoe").
: entry("Daniel Defoe", 1722, "Captain Singleton").
: entry("Charles Dickens", 1837, "The Pickwick Papers").
: entry("Charles Dickens", 1838, "Oliver Twist").
: entry("Charles Dickens", 1839, "Nicholas Nickleby").
: entry("Charles Dickens", 1841, "The Old Curiosity Shop").
: entry("Charles Dickens", 1843, "A Christmas Carol").
: entry("Charles Dickens", 1845, "The Cricket on the Hearth").
: entry("Charles Dickens", 1850, "David Copperfield").
: entry("Charles Dickens", 1859, "A Tale of Two Cities").
: entry("Charles Dickens", 1861, "Great Expectations").
```

Not just another programming language

PROGRAMMING IN LOGIC

Each entry is a unit clause, or fact, consisting of a compound term whose principal **functor** is the **atom** 'entry'. The **term** has three **arguments**, that is, it has an **arity** of three. The first and third arguments are strings and the second is an integer.

The data structure of PROLOG is the term, and there are both simple and compound terms. A **simple term** is a constant; either an integer, an atom or a string. A **compound term** has a functor and arguments. Each argument is itself a term, while the functor is an atom.

The atoms are the building blocks from which PROLOG programs are made. They are usually just words. Strictly speaking, **integers** and **strings** are also atomic, but it is convenient to distinguish them.

PROLOG also has a third kind of term, the variable. **Variable names** are similar to atom names except that some convention is used to distinguish between them! The

usual convention is that variable names start with a capital letter while atoms start with a lower case letter. The remaining characters of the names may be any alphanumeric characters, i.e: any digit, upper case or lower case letter.

However, there may also be a number of other allowable characters, such as underscore, '_'. A **string** is any sequence of printable characters enclosed in matching quotes (single or double or either, according to your whim).

Interrogation — the question

PROLOG's use of its variables makes it unique among computer languages. A PROLOG variable is **bound** rather than assigned to — and under certain circumstances it may be **unbound** and **rebound**. Consider the following questions and the system's responses:

```
cat.2)
?- entry("Charles Dickens", 1839, Title).
?- % What did Dickens write in 1839?
Title = "Nicholas Nickleby"
cat.3)
?- entry(Author, 1839, Title).
?- % What books were written in 1839 and by whom?
Author = "Charles Dickens"
Title = "Nicholas Nickleby"
cat.4)
?- entry("Daniel Defoe", Date, Title).
?- % What did Defoe write and when?
Date = 1719
Title = "Robinson Crusoe"
Date = 1722
Title = "Captain Singleton"
cat.5)
?- entry(Author, 1837, Title1), entry(Author, 1839, Title2).
?- % Who wrote books in both 1837 and 1839 and what were they?
Author = "Charles Dickens"
Title2 = "Nicholas Nickleby"
Title1 = "The Pickwick Papers"
cat.6)
?- entry("Charles Dickens", 1843, "A Christmas Carol")
?- % Did Dickens in 1843 write "A Christmas Carol"?
** yes
cat.7)
?- entry(Author, 1739, Title).
?- % What books were written in 1739 and by whom?
** no
```

Note that, apart from inside a string, an initial capital letter indicates a variable (and a comment is introduced by '%'). As you can see, every entry matched by a term of a question has resulted in a **binding** to the variables involved, and the system has automatically printed out each binding.

In example 'cat.4' there were two possible sets of bindings and both sets were printed. In the case of example 'cat.5', any set of **variable bindings** had to give rise to a match for both terms. Where no bindings were made to variables, the system simply answered the question with a yes/no response ('cat.6', 'cat.7').

An **unbound variable** is like a blank

mould ready to accept the imprint of whatever it is matched against. When the context of a variable is successfully matched, the variable will be bound to the term in the corresponding position. Thus a **bound variable** carries the stamp of its match, and has become indistinguishable from the original.

In processing a question, the system uses each term successively (from left to right) as a goal, seeking to match the **goal** against the **clauses** in the database. Due to the variables involved this is not just a case of matching character by character, but involves finding the appropriate substitutions (bindings) for the variables, so as to make the terms identical. This process of unification is nonetheless not much more complex than the straightforward exact match.

If the matching of a goal against a particular clause fails at some point, then any variables bound during the match must be unbound, and the search for a match will then continue with the following clause, if any. But if there are no more clauses, and no match has been found, the goal fails. However, if ever a match is found, the goal succeeds. In fact, if a number of matches exist they will all be found and the goal will succeed as many times.

Where the goal is the sole goal of a question, the effect will be that the bindings for each match are printed. Thus if a number of solutions exist (as with the third question presented above) PROLOG will find and print them all.

If more than one goal is specified (as in example 'cat.5') then all of them must be simultaneously satisfied by the one set of bindings, in order for a solution to exist. To achieve this, the later goals are attempted using each of the possible matches for the earlier goals. The backtracking algorithm which PROLOG uses to juggle all these bindings will be explained further in a later article.

Proofs — the command

It will be observed that the goal looks like, and corresponds roughly with, a procedure call in a conventional programming language. There are, however, some big differences. The principal functor of a goal is known as a **predicate**. The term predicate comes over from first order logic, and a predicate differs from a procedure in that a predicate specifies a logical relationship which holds for the goal i.e: upon which success is predicated. A procedure specifies an algorithmic method for achieving the goal i.e: how to proceed.

For this reason PROLOG is more like automatic programming, or program proving, than programming in the conventional sense. In PROLOG the system's in-built algorithms are employed, in a deterministic manner, to achieve the goal state specified by the programmer e.g: to prove the fact that an (unknown) author (or authors) wrote two (unknown) titles whose publication dates are known ('cat.5'). In the process, the unknowns are identified.

The question is but one of three related contexts in which a goal may appear. The second is the **command**, which differs from the question in that no automatic printing of variable bindings occurs, and in that only a single way of achieving the goal is found. A command simply succeeds or fails according to whether or not a proof is found.

Thus, if a command is employed any printing to be done has to be achieved through side-effects; the usual purpose of a command is to achieve particular side-effects. In addition, since it is seeking to establish the truth of the goals rather than to print a list of solutions, it will cease its

search as soon as it has found one set of satisfying variable bindings.

A number of special in-built predicates exist to provide input and output functions. Consider these commands and responses:

cat.8)

`:- entry("Daniel Defoe", Date, Title).`
`:- % No output.`

cat.9)

`:- entry("Daniel Defoe", Date, Title), nl,`
`write>Title), nl.`
`:- % Write one title only.`

"Robinson Crusoe"

In example 'cat.9' the predicates 'nl' and 'write' are used to move to a new line and write out the term specified. Note that without these special predicates and their side-effects ('cat.8') no output is produced.

Employing them ('cat.9'), the first solution to be found has its title written out, but the other solution isn't found. This illustrates that the bindings achieved by the first goal mean that the variable 'Title' is indistinguishable from the string "Robinson Crusoe" when the system moves on to prove the subsequent goals.

Implications — the non-unit clause

The question and the command are both directives. Together with the clause these comprise the sentences of the language. We have already met the unit clause (facts — see 'cat.1'), and we now meet the non-unit clause or **implication**.

cat.10)

`do :- entry("Daniel Defoe", Date, Title),`
`nl, write>Title), nl.`

cat.11)

`author>Title, Author) :- entryAuthor,`
`Date Title).`

The ':-' may be read as 'neck' or 'if'. The effect of the first of these clauses is to define the head goal 'do' in terms of the goals 'entry', 'write' and 'nl' which comprise the body of the clause. The effect is that the goal 'do' will succeed if the goals in the body all succeed. The command

cat.12)

`:- do.`
`"Robinson Crusoe"`

is now equivalent to the command 'cat.9' shown earlier.

What we are seeing here is a second way in which a goal can be achieved. Not only can a goal succeed by finding substitutions to make it match one of the facts (i.e. a unit clause), but it will also succeed by finding substitutions to make it match the conclusion (the head) of an implication (a non-unit clause) if it, in addition, succeeds in satisfying all the conditions of the implication, i.e. all the goals in the body of the clause.

The second non-unit clause exemplified above ('cat.11') defines the predicate `author` with the semantics '(the) author (of) Title (is) Author'.

Hence the meaning of the entire clause is '(the) author (of) Title (is) Author' if (there is) '(an) entry (for a work by) Author (at some) Date (entitled) Title'.

Note the distinction between the atom 'author' and the variable 'Author'.

We can now use 'author' to find out who wrote "Oliver Twist":

cat.13)

`?- author("Oliver Twist", Author).`
`% Who is the author of Oliver Twist?`

Author = "Charles Dickens"

Do you see what I have done here in defining the predicate 'author'? I find it a helpful mnemonic device to keep in mind a phrase describing the predicate such that the functor and argument roles appear in the chosen order.

Since the order can be chosen arbitrarily, failure to choose a sensible convention and use it consistently may result in you forgetting which way round the arguments are meant to go — or worse yet, accidentally inverting them from time to time.

There are a couple more twists to this story. We can use our predicate 'author' backwards as well, to find out what books a given author has written:

cat.14)

`?- author>Title, "Jonathan Swift").`
`% What books is Swift the author of?`

Title = "A Tale of A Tub"

Title = "Gulliver's Travels"

In English we can also talk about who wrote something, as I did before, and of course we are really talking about who its author is. In PROLOG we can freely define new predicates in terms of any available predicates — whether they are defined as built-ins, facts or implications; whether they

FAMILY TREES — examples

Here is a PROLOG example involving another database — a small family tree. Can you work out what is happening and why? Try to put the relationships into English so as to reflect the order of arguments.

fam.1)

`% The cast (by sex).`

`% ~~~~ ~~~~ ~~~~`

`:- female("Susan").`

`:- male("Richard").`

`:- male("Michael").`

`:- male("George").`

`:- female("Helen").`

`:- male("Anthony").`

`:- female("Natalie").`

`:- male("John").`

`:- female("Elizabeth").`

fam.2)

`% The relationships.`

`% ~~~~ ~~~~`

`:- father("Susan", "George").`

`:- father("Richard", "George").`

`:- father("Michael", "George").`

`:- mother("Susan", "Helen").`

`:- mother("Richard", "Helen").`

`:- mother("Michael", "Helen").`

`:- father("George", "Anthony").`

`:- mother("George", "Natalie").`

`:- father("Helen", "John").`

`:- mother("Helen", "Elizabeth").`

fam.3)

`% Childhood rules.`

`% ~~~~ ~~~~`

`:- child(Child, Parent) :- father(Child, Parent).`

`:- child(Child, Parent) :- mother(Child, Parent).`

`:- son(Child, Parent) :- male(Child), child(Child, Parent).`

`:- daughter(Child, Parent) :- female(Child), child(Child, Parent).`

fam.4)

`?- son("George", Who).`

`% Who is a son of George?`

Who = "Richard"

Who = "Michael"

fam.5)

`?- child(Who, "Susan").`

`% Whose child is Susan?`

Who = "George"

Who = "Helen"

are defined earlier or later; and even if they include the predicate currently being defined or extended. Hence we can store an implication to the effect that '(the person who) wrote Title (is) Author' if

'(the) author (of) Title (is) Author'

viz:

cat.15)

`wrote>Title, Author) :- author>Title,`

`Author).`

`% Whoever wrote Title is the author`

`of Title`

cat.16)

`?- wrote("Oliver Twist", Author).`

`% Who wrote Oliver Twist?`

Author = "Charles Dickens"

cat.17)

`?- wrote>Title, "Jonathan Swift").`

`% What are the books Swift wrote?`

Title = "A Tale of A Tub"

Title = "Gulliver's Travels"

NOT A PROGRAMMING LANGUAGE

Here are some of the factors which distinguish PROLOG from other computer languages:

- developed for language research
- developed out of theorem proving research
- encompasses automatic programming
- encompasses program proving
- non-algorithmic — specifactory
- non-prescriptive — descriptive
- non-procedural — declarative/denotative
- allows easy documentation
- allows readable self-modifying programs
- allows customized/expansible database access formats
- has pedagogical advantages as a first computing language
- has potential for multiprocessing
- has potential for generalisation
- used for artificial intelligence applications
- used for pattern recognition applications
- used for database applications
- used for parsing applications
- used for expert systems
- used for symbolic algebra
- underlies Japanese fifth generation computer systems development

Many of these points will be expanded or exemplified more fully during this series of articles.

The ghostly background. At left — LOG, at right — PRO(fessional)LOG!

PROGRAMMING IN LOGIC

CURRENT IMPLEMENTATIONS

Since the original Marseilles interpreter, there have been quite a number of implementations of PROLOG produced. Although they appear to be heading towards some sort of standard syntax, close to that used here, there are significant differences.

Also one of the most recent PROLOG interpreters has departed quite radically from this syntax — this is Micro-PROLOG, the first implementation produced for personal computers. This system, from Logic Programming Associates Ltd, London, is available for Z80-based microcomputers and is becoming available for the 6502 and others shortly.

Other implementations have been produced in university research environments and are not readily available for personal computer users, although announcements of several other micro implementations are expected soon. The other systems that I know about in any detail are all based on DEC hardware, although the UNIX implementations should be easily portable to other systems.

Whereas the original Marseilles implementation was a direct takeover of notation from Resolution Theorem Proving, the common notation (as used in this article) is oriented towards user convenience and comprehension.

The Micro-PROLOG implementation uses an 'internal syntax' which is LISP-like and oriented towards the convenience of the implementor (simplifying the internal parsing). It also provides an English-like 'surface syntax' for the convenience of the novice computer user. This surface syntax is transparently converted into the 'internal syntax' by a PROLOG program which may be invoked by the user.

A fuller 'Comparison of Implementations' will be given in a later article. For now, no execution of PROLOG is necessary, but the examples and exercises should be worked through by hand. Suggestions about getting access to a PROLOG system will also be given later.

Now that we have been introduced to all the different types of sentence and we have seen quite a few examples, there is one essential point about variables that must be driven home. You will have noticed that in the examples I gave I have repeatedly made use of the same variables: 'Author', 'Title' and 'Date'. There has been no confusion because a variable is not, I repeat, *not* a particular location somewhere inside the computer's memory.

On the contrary, a variable name is significant only within a *single* sentence. The name of a variable is used to distinguish between different variables within the one sentence, to identify when any term to which the variable is bound must match in a number of contexts in the one sentence, and to label what is being printed in response to the one question.

Every sentence has its truth bound up only in the relationships expressed within it, whether fact, implication, or directive, irrespective of any usage of the same variable names elsewhere.

Thus the fact that two variable names are the same only means that the same variable binding is being referred to if and only if, when and only when, they occur in a single

usage of one and the same sentence. In fact, whenever a sentence is used in the search process, a fresh set of variables is employed.

This is important because, as we will discover in the next article, the one sentence can be used more than once in the course of executing a single directive or matching a single goal.

Recapitulation — syntax and semantics

Let's just run over the types of sentence again quickly. A sentence is defined as having a head, a neck and a body, although in various circumstances each one of these can be empty or omitted.

It will be observed that a sentence with an empty body is a unit clause, and is used with the neck omitted. A sentence with an empty head is a directive; a question if the neck takes the form ':-' (query), and a command if it takes the usual form ':-'.

A sentence with both head and body non-empty is a non-unit clause. A sentence cannot have both head and body empty.

This completes your introduction to the standard syntax of PROLOG. The semantics have also been outlined, but will be summarized again now.

A directive succeeds if there exist one or more substitutions for which every one of the goals succeeds. A goal matches if it is unifiable with the head of one or more clauses. In the case of a unit clause a match means immediate success.

But for a non-unit clause success also depends on the existence of a substitution (a set of bindings consistent with existing bindings) for which every one of the goals in the clause body succeeds.

The program is a conjunction of clauses, all declared to be true for all substitutions of variables; each unit clause representing a simple fact and each non-unit clause representing an implication. It will prove helpful if you read the neck, ':-' as 'if'. Also the alternative (but less common) notation '<-' conveys the idea most helpfully.

Although the complete syntax and semantics of pure PROLOG has been covered, there is still a certain amount of 'syntactic sugar' which augments the logical syntax of PROLOG. These enhancements only make it more convenient for the programmer and do not actually augment the power of the language — they are all basically just concessions to readability.

There also remain a number of in-built predicates, two of which have been introduced already ('write' and 'nl'). Many of these vary from implementation to implementation, but some are universally available, even though they may differ in name or precise syntax.

These extensions to the basic framework of PROLOG will be introduced, as required, in future parts. Part 2 will delve into recursion in PROLOG and will introduce the list. For now you are left with a number of graded examples to try.

FAMILY TREES — exercises

How did you go at figuring out the family tree examples given in a previous panel? There was one place where you may not have been sure what was going on (but I hope you worked it out eventually), and that is the way in which 'child' is defined.

Someone is a child of someone else if the 'someone else' is his/her father; and someone is a child of someone else if the 'someone else' is his/her mother. You may have thought it strange that I used 'and' back there. But I want to emphasise that *both* rules are always true — it is not that one rule is true or the other is true, since both are true. Which rule succeeds will depend on what goal is being matched.

Note the way in which in 'fam.5' *both* 'child' rules are used successfully, so that both parents are found.

Here is a graded list, easiest first, of predicates you might like to define so as to extend the family database: the facts about your own family tree (include surnames or a distinguishing initial or number if a number of people have the same first name); the implications for

1. 'parent', 'grandmother', 'grandparent', 'grandson', 'grandchild' (these are simple, you should be able to find both one line and two line solutions in each case).

2. 'husband', 'wife', 'spouse' (these are possible, as it stands, only for parents — if these are childless couples in your extended family you may have to introduce some facts defining the predicate 'married').

3. 'sister', 'brother', 'sibling', 'aunt', 'uncle' (try these before reading the remainder of this comment) ... now that you have a solution see if it says sibling ("Susan", "Susan") is true and returns "Richard", "Michael" and "George" for brother("George", Brother), see if you can fix up your predicates by making use of the built-in predicate 'ne' which is defined so that ne(X, Y) succeeds if X is not equal to Y and fails if they are equal).

4. 'ancestor' and 'descendant' (these involve recursion — which we will be looking at in the next article — but see if you can figure it out anyway by remembering that any predicate may be made a condition in any predicate definition — even its own!).

To finish off with something a little easier, how about figuring out what facts and implications you could add to allow for pets, or addresses etc.

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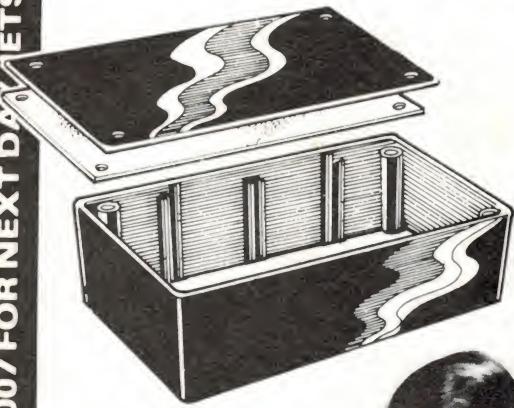
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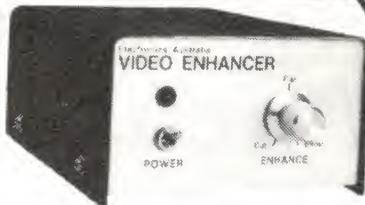
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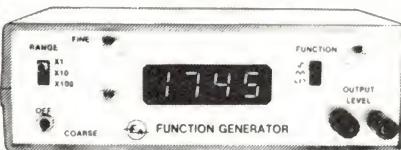
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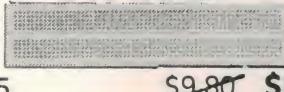
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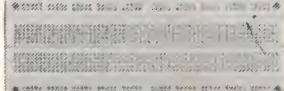
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The 6800 microprocessor series

Part 3 – the VIA

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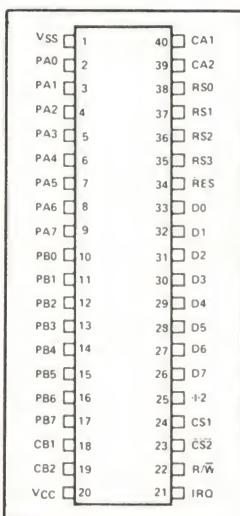


Figure 1a

MOST manufacturers of microprocessor ICs do not design the microprocessors themselves as individual components but rather as the heart of a family of ICs. The individual members of a family are capable of performing specific tasks and are able to communicate with each other with a minimum amount of interconnection. Some of the specific tasks include parallel I/O, serial I/O, timers and counters, memory, etc. As mentioned in Part 1 of this series (*The 6800 Microprocessor Series*, March 1984 ETI), it is possible to use various components from different microprocessor families if care is taken with a signal compatibility.

During the design of the ETI-662a General Purpose Microprocessor System (April 1984 ETI), I selected the Synertek SY6522 Versatile Interface Adapter (VIA) from the 6500 family to be the interface IC. This is a good example of the compatibility possible between some families (the processor belonging to the 6800 family).

The SY6522 VIA

The Synertek 6522 VIA is certainly a versatile I/O device. Its features include:

- two 8-bit bi-directional I/O ports,
- two 16-bit programmable timer/counters,
- serial data port,
- automatic handshaking capability,
- latched output and input registers,
- seven interrupt conditions.

Pin functions

The VIA is a 40-pin device available as the 1 MHz SY6522 or the 2 MHz SY6522A. Its external pin connections fall into one of two categories — those which connect to the microprocessor's busses and those which connect to the outside world (see Figure 1a).

General purpose, minimum component microprocessor system

A microprocessor dedicated to controlling some piece of equipment needs to have certain I/O facilities

For a general purpose dedicated microprocessor these facilities need to be as versatile as possible.

Connection to the micro

Exactly half of the VIA's pins are involved in interfacing with a processor's control, data, address and power supply busses. These enable data to be correctly transferred between the processor and its VIA

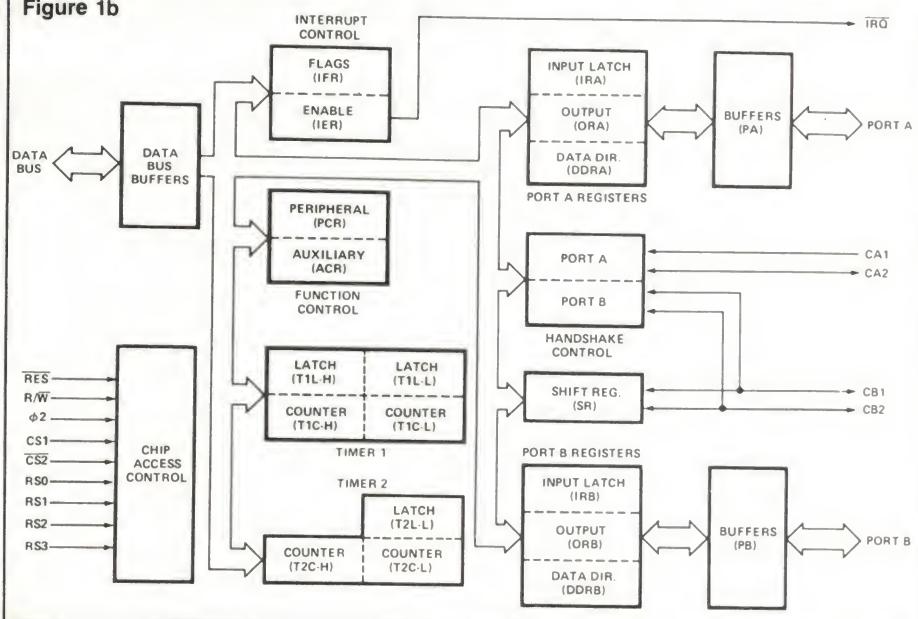
The power supply connections to the VIA are pins 20 and 1 (+5 V and 0 V, respectively) and the power consumption is 700 mW.

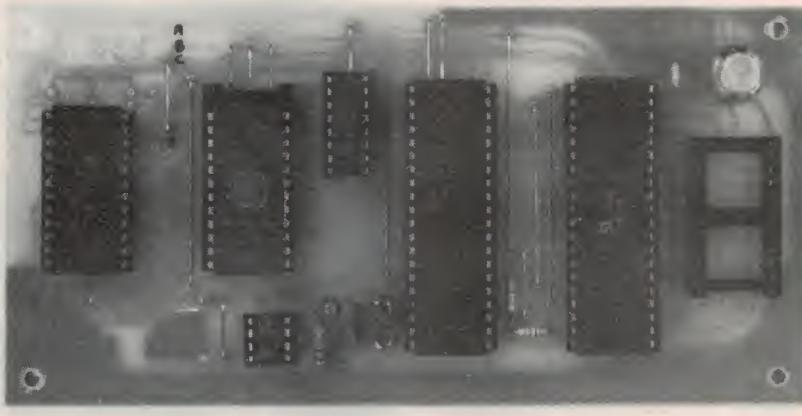
Pin 34 is the reset input and is normally driven by the same power-on-reset circuitry as the processor. This results in all the inter-

nal registers (except timer latches, counters and the shift register) being cleared, peripheral interface lines placed in the input state and interrupts disabled at switch-on.

Pins 22 and 25 are R/W and E respectively. They connect to the equivalent pins on the processor and allow for correct data transfer between the processor and VIA. The R/W line indicates the direction of data transfer — a low indicating that the processor is *writing* to the VIA and a high indicating that one of the VIA registers is being *read*. The E signal is simply the system clock and is used to synchronise all data transfers. It is

Figure 1b





also used as a timing signal for the two timer/counters. More of this later.

Pins 26 to 32, inclusive, comprise the eight bi-directional data lines. It is along this buss that data travels between the processor and VIA. When the VIA is not being accessed, the lines go into the high impedance state so as not to load the data buss and interfere with other data transfers.

Pins 35 to 38 are the register select inputs RS3, RS2, RS1 and RS0. When connected to four of the microprocessor address lines they allow one of the VIA's sixteen registers to be selected for data transfers. Two enable lines are also available for connection to the system's decoding circuitry so that the VIA can be positioned somewhere in the microprocessor address space. In other words, these six lines are used to give each of the VIA's sixteen internal registers a different address so that information can be written to or obtained from them. Note that the device is enabled when CS1 is high and CS2 is low.

Pin 21 is the final microprocessor/VIA control signal and is the interrupt request output (IRQ). This line usually connects to IRQ on the microprocessor and goes low when an interrupt condition exists in the VIA.

Connection to the outside world

The remaining 20 lines comprise Port A, Port B and their handshake lines. Both ports consist of eight lines which can be individually programmed to function as inputs or outputs. They each appear as a TTL load in input mode and can drive one standard TTL load in output mode. Port B, in addition, is capable of sourcing 1 mA at 1.5 volts in the output mode and can directly drive transistor circuits.

The handshake lines are known as CA1, CA2 for Port A and CB1, CB2 for Port B. They can act as interrupt inputs or handshake outputs as selected by certain registers (discussed later). The difference between them is that CA1 and CB1 are inputs only — CA1 having a high input

impedance and CB1 appearing as a TTL input.

Lines CA2 and CB2, on the other hand, can be inputs or outputs — in input mode they appear as TTL inputs; in output mode they can drive a standard TTL load.

Under certain conditions CB1, CB2, PB6 and PB7 take on different functions and these will be discussed in the next section.

Functional description

As mentioned previously, there are sixteen registers in the VIA. Most of these are used to set up its operating properties, the rest are involved with actual data transfer. Figure 1b shows the overall internal structure and Table 1 lists the functions of each of the registers. Let's look at them now in detail since they hold the key to the operation of the device.

The first two registers, R0 and R1, are Ports B and A respectively. It is through these two registers that data flows to and from the outside world — these registers are actually connected to the 16 I/O pins of the VIA.

To specify which bits in Port A and B will be inputs or outputs, a couple of "data direction" registers are provided. These are registers R2 (data direction register B or DDRB) and R3 (data direction register A or DDRA). A zero (0) stored in a bit of a data direction register causes the corresponding port pin to act as an input. A one (1) causes it to act as an output. Let's look at an example.

To set-up Port A as, say, 4 output lines (bits 7, 6, 5 and 4) and four input lines (bits 3, 2, 1 and 0) simply store \$F0 (11110000 in binary) in register R3. If data is now written to register R1, the upper four bits will appear on pins 6 to 9 (PA4 to PA7) of the VIA. If data is read from register R1, then the logic levels on pins 2 to 5 (PA0 to PA3) is the information read. Simple, isn't it!!

Since the I/O ports are most often used for transferring data in parallel form, either to a printer or from a keyboard, it is possible to implement handshake control of data transfers with the 6522 VIA. Port A control lines (CA1, CA2) handshake on both a read and write operation, whereas Port B lines (CB1, CB2) handshake on write only.

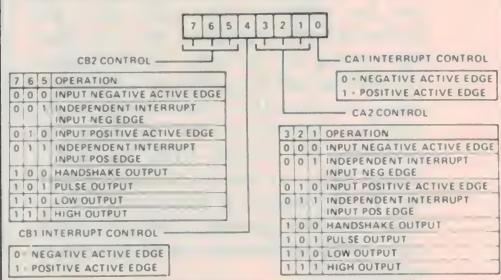
With the read handshake as an example, the peripheral device (e.g: keyboard) must generate the equivalent of a "data ready" signal to indicate to the processor that valid data is present on the port. This signal normally interrupts the processor which then reads the data causing a "data taken" signal to be generated. The peripheral device responds by making new data available, and ▶

Table 1

Register Number	RS Coding				Register Desig.	Description	
	RS3	RS2	RS1	RS0		Write	Read
0	0	0	0	0	ORB/IRB	Output Register "B"	Input Register "B"
1	0	0	0	1	ORA/IRA	Output Register "A"	Input Register "A"
2	0	0	1	0	DDRB	Data Direction Register "B"	
3	0	0	1	1	DDRA	Data Direction Register "A"	
4	0	1	0	0	T1C-L	T1 Low-Order Latches	T1 Low-Order Counter
5	0	1	0	1	T1C-H	T1 High-Order Counter	
6	0	1	1	0	T1L-L	T1 Low-Order Latches	
7	0	1	1	1	T1L-H	T1 High-Order Latches	
8	1	0	0	0	T2C-L	T2 Low-Order Latches	T2 Low-Order Counter
9	1	0	0	1	T2C-H	T2 High-Order Counter	
10	1	0	1	0	SR	Shift Register	
11	1	0	1	1	ACR	Auxiliary Control Register	
12	1	1	0	0	PCR	Peripheral Control Register	
13	1	1	0	1	IFR	Interrupt Flag Register	
14	1	1	1	0	IER	Interrupt Enable Register	
15	1	1	1	1	ORA/IRA	Same as Reg 1 Except No "Handshake"	

Figure 2

REG 12 — PERIPHERAL CONTROL REGISTER



The 6800 microprocessor series

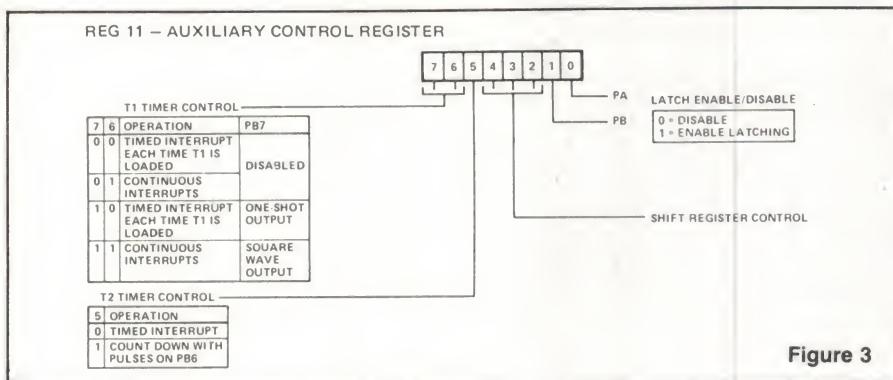


Figure 3

so forth until data transfer is complete.

The "data taken" signal can be either a pulse or a level and the "data ready" signal normally sets an internal interrupt flag which may interrupt the processor or may be polled under program control.

Figure 2 illustrates the register responsible for selection of operating modes for CA1, CA2, CB1 and CB2. It is register R12, the Peripheral Control Register.

There are two timers available for use in the 6522. Their operations differ slightly so it's probably best to examine each separately. Timer one (T1) consists of two 8-bit latches and a 16-bit counter. The latches are used to store data which is to be loaded into the counter. After loading, the counter decrements at the E signal clock rate (1 MHz). When zero is reached, an interrupt flag will be set and IRQ will go low if the interrupt is enabled (discussed in detail later). At this stage, one of four possible operations may occur:

1. the timer will disable further interrupts (called "one-shot" mode since a single interrupt is produced);
2. the timer will transfer the contents of the latches into the counter and begin decrementing again;
3. the timer operates as for condition (1) but will put a low on peripheral line PB7 during the decrement period. In other words, a single negative pulse is produced, the length of which is equal to the number of microseconds it takes to decrement the counter; and
4. the timer operates as for condition (2) but inverts the output signal on PB7 each time it reaches zero. This effectively produces a square wave output on PB7. If new data is written into the latches before zero is reached (time-out), the current time-out period will not be affected. The new data will determine the length of the *next time-out period*. In this way, very complex waveforms can be generated. It is interesting to note that both timers in the 6522 are "re-triggerable" meaning that reloading the counter from the latches before time-out extends the timing period. If the counter is reloaded continuously by the processor before zero is reached then time-out can be prevented completely!

Figure 3 shows R11, the Auxiliary Control Register. Its two most significant bits control the four modes of operation of timer one. The tricky part with initialising the timer has to do with loading its latches and counter. The high and low order bytes of the counter cannot be loaded directly but can be read at any time.

To initialise the counter, firstly the low order byte is written to either register 4 or 6. This results in the byte being placed in the lower byte of timer one's latch. Next, the high order byte is loaded into register R5. This causes —

- (a) the high order byte to be loaded into the higher byte of the latch and the counter,
- (b) the low order byte of the latch to be transferred to the low byte of the counter.
- (c) the interrupt flag to be reset and
- (d) the countdown to begin.

If, instead, the byte was loaded into register R7, then *no transfer to counter takes place*. The value is simply placed in the latch's high order byte.

Timer two (R2) also has two 8-bit latches and a 16-bit counter of which the low-order latch is write only, the low order counter is read only and the high order counter is read/write. It has two modes of operation selected by bit 5 of the Auxiliary Control Register. Its "one-shot" mode is similar to timer one where an interrupt is generated when the counter reaches zero. The counters then "roll-over" to all ones

(\$FFFF) and continue decrementing so that it is possible to determine how long it's been since time-out.

The setting of the interrupt flag, however, is disabled after the initial time-out so that the next decrement through zero has no other effect. The interrupt flag can be reset by reading the counter's low order byte or by writing to its high order byte (which also loads both high and low bytes from the latches).

Timer two's second mode of operation is as a pulse counter. Basically, it counts a predetermined number of negative-going pulses on peripheral line PB6 (these pulses actually decrement the counter instead of the E signal). The interrupt operates as for the first mode.

The Shift Register (R10) is linked to the CB2 and CB1 pins, has a built-in modulo-8 counter (shift register counter) and has eight modes of operation. The operating mode is selected by bits 4, 3 and 2 of the Auxiliary Control Register (see Figure 4).

The first mode is SR DISABLED.

The second mode is SHIFT IN UNDER CONTROL OF T2. Data is shifted into the register, low bit first, from CB2 at a rate determined by the low order byte of T2. Timing pulses are generated on the CB1 line to synchronise transfer with an external device. The shifting operation is triggered by reading or writing the Shift Register and after eight shifts, the shift register interrupt flag will be set.

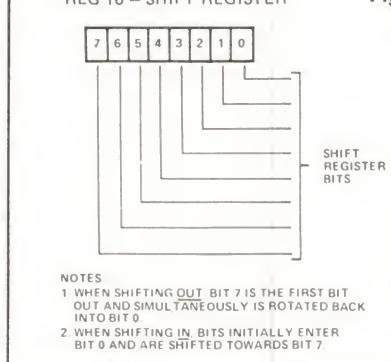
Mode 3 is SHIFT IN UNDER CONTROL OF E SIGNAL. This is identical to mode 2 except that the shift rate is 1 MHz.

Mode 4 is SHIFT IN UNDER CONTROL OF EXTERNAL CB1 CLOCK. Here, CB1 becomes an input and allows an external device to shift data into CB2 at its own pace. The interrupt is set after eight shifts but note that this does not stop the shifting operation. Reading or writing the shift register resets the interrupt flag and initialises the shift register counter to count another eight pulses.

Mode 5 is SHIFT OUT FREE-RUNNING AT T2 RATE. This is very similar to the next mode except that the shifting operation is not stopped after eight shifts and the interrupt flag is never set. Note that bit 7 of the Shift Register is recirculated back into bit 0 and so the bit pattern stored there will be continuously output.

Mode 6 is SHIFT OUT UNDER CONTROL OF T2. With each read or write of the shift register, the SR counter is reset ▶

Figure 4



REG 11 - AUXILIARY CONTROL REGISTER

4	3	2	OPERATION
0	0	0	DISABLED
0	0	1	SHIFT IN UNDER CONTROL OF T2
0	1	0	SHIFT IN UNDER CONTROL OF I ₂
0	1	1	SHIFT IN UNDER CONTROL OF EXT CLK
1	0	0	SHIFT OUT FREE RUNNING AT T2 RATE
1	0	1	SHIFT OUT UNDER CONTROL OF T2
1	1	0	SHIFT OUT UNDER CONTROL OF I ₂
1	1	1	SHIFT OUT UNDER CONTROL OF EXT CLK

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and the eight bits are shifted onto CB2 (timing pulses are generated on CB1). After eight shifts, the shifting function is disabled and the interrupt flag is set.

Mode 7 is SHIFT OUT UNDER CONTROL OF E SIGNAL. This is as for mode 6 except shift rate is 1 MHz.

Mode 8 is SHIFT OUT UNDER CONTROL OF EXTERNAL CB1 CLOCK. This is very similar to mode 4 where an external device controls the shift rate.

The final two registers are the Interrupt Flag Register (R13) and the Interrupt Enable Register (R14). Seven of the bits in the IFR represent the status of each of the

seven interrupting conditions possible with the VIA.

If an interrupt condition exists, for example eight shifts of the shift register or a time-out of one of the timers etc, then the appropriate bit in the IFR will be set to a one (1) if that interrupt is enabled. The bit can be cleared by either resetting the interrupt condition, for example rewriting the shift register or reloading the counter etc, or by writing a one to that bit in the IFR. Bit 7 is not a flag but represents the logic level on IRQ and is set if any of the other seven bits are set.

This allows a processor to poll all the interrupts by simply checking the bit. It can only be cleared by clearing the other seven flags in the IFR or by disabling all active interrupts.

For each bit in the IFR, there is a corresponding bit in the IER (R14). This allows individual control of each of the seven interrupting conditions. To enable an interrupt, the processor needs to set the appropriate bit *while writing a one into bit 7* (refer to Figure 5).

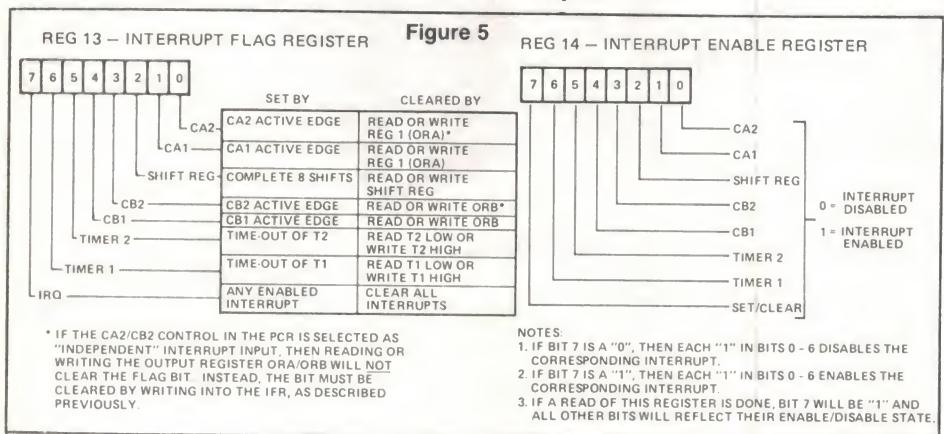
For example, to enable timer 1 and the shift register, simply load R14 with \$C4 (11000100). If any of the other interrupts were enabled prior to this, then they will still be enabled. In other words, writing a zero to a bit of the IER while having a one in bit 7 has no effect on that bit. To clear a specific bit of the IER the processor needs to write to R14 with a zero in bit 7. A one in any other bit position will clear the corresponding bit whereas a zero will have no effect.

For example, let's assume that interrupts for timer 1 and the shift register are enabled. The IER will contain 01000100. To enable interrupts for timer 2 as well, simply write 10100000 to the register after which it will contain 01100100. To disable SR interrupts, write 00000100 to R14 which will leave it with 01100000.

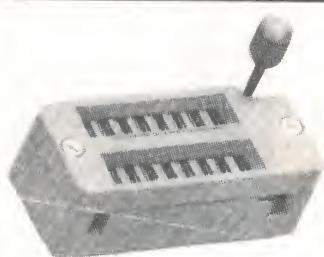
After all this you should realise that the 6522 is certainly a *versatile* Interface Adapter.

Some of the sections may need re-reading in case it didn't all click (or should that be *beep?*) the first time through but I recommend that you obtain the manufacturer's data sheet if any problems do arise or if any serious work needs to be done. Happy interfacing!

Figure 5



TEXTOOL ZERO INSERTION FORCE SOCKETS



ZIP DIP II Sockets

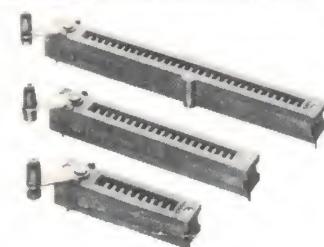
TEXTOOL'S versatile ZIP DIP II socket features a flat top plate for easy insertion and extraction. Contacts are on 1" increments for standard sizes, thus mating with standard layouts. All standard sizes from 14 to 40 pin are available from stock at realistic prices.

Pin	Stock Number	Price
14	PB01	9.81
16	PB02	7.19
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20	PB04	9.36
22	PB05	14.52
24	PB06	7.94
28	PB07	8.00
40	PB08	14.00
64	PB29	39.52

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For applications requiring low cost for not so often used sockets the ECONO-ZIP is the answer. A simple mechanism is used with contacts and body of standard TEXTOOL materials. Ideal for use on P.C.B.'s within equipment for PROMS or EPROMS. Available immediately in 16, 24, 28 and 40 pin, others to follow.

Pins	Stock Number	Price
16	PB20	7.15
24	PB24	7.00
28	PB25	9.11
40	PB26	11.66
64	PB28	16.75



ZIP-STRIPS

Combine all the usual TEXTOOL features into a useful socket for testing non-standard packages or pinned board assemblies. The ZIP-STRIP handles may be ganged for ease of use.

Pins	Stock Number	Price
10	PB17	11.58
20	PB18	15.35
32	PB27	17.43

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437 City Rd., Sth. Melbourne. Phone: (03) 690 8333

LISTING :

```

0600 6c18 6d0e 6e06 620f 6500 26cc 26f8 26e2
0610 6700 6600 6306 26cc 6005 e0a1 7cfe 6007
0620 e0a1 7e02 6006 e0a1 7dfe 600e e0a1 7d02
0630 6009 e09e 163a 3e06 7e01 6001 e09e 1644
0640 3e00 7eff 26cc 26e2 7401 4420 26f8 270e
0650 26e2 7601 f600 f218 4764 6501 46ff 1698
0660 5ca0 1616 5db0 1616 5e90 1616 6020 f000
0670 f218 7002 3080 166e 7705 3732 1684 08e1
0680 08e1 6302 3764 168e 6501 08e1 6304 3796
0690 1616 08e1 08e1 6300 00e0 6a18 6b0a 6c8
06a0 f733 f265 f029 dab5 f129 7a05 dab5 f229
06b0 7a05 dab5 6008 e09e 16b4 00e0 8030 b6c0
06c0 08e1 08e1 08e1 1600 ---- -- a8da fe1e
06d0 f065 a736 f01e 80c0 7008 dcdf f21e d0df
06e0 00ee a8d0 f91e f065 a808 f01e 80a0 7008
06f0 dabf f21e d0bf 00ee 6400 ca0f 8a44 7a0e
0700 cb07 8b4b 700e c907 4907 6903 00ee c00f
0710 4501 c007 4000 7a02 4001 7a0e 4002 7b02
0720 4003 7bfe 4004 79ff 4005 7901 49ff 6901
0730 4907 6905 00ee 0000 0000 0000 0302 0300
0740 0000 0000 0000 0000 0000 0000 0800 8080
0750 0000 0000 0000 0000 0000 0007 0404 0407 0000
0760 0000 0000 0000 0000 c040 4040 c000 0000
0770 0000 0000 0000 0f08 0808 0808 0f00 0000
0780 0000 0000 00e0 2020 2020 20e0 0000 0000
0790 0000 001f 1010 1010 1010 101f 0000 0000
07a0 0000 0010 1010 1010 1010 1010 0000 0000
07b0 3f20 2020 2020 2020 2020 3f00 0000 00f8
07c0 0808 0808 0808 0808 0808 0808 0000 007f 4040
07d0 4040 4040 4040 4040 4040 407f 0000 fc04 0404
07e0 0404 0404 0404 0404 0404 fc00 ff80 8080 8080
07f0 8080 8080 8080 8080 fffe 0202 0202 0202
0800 0202 0202 0202 02fe 0000 0000 0000 0001
0810 0000 0000 0000 0000 0000 0000 0000 0000
0820 0000 0000 0000 0000 0000 0000 0303 0300
0830 0000 0000 0000 0000 0000 0000 0800 8080 0000
0840 0000 0000 0000 0000 0000 0007 0707 0707 0000
0850 0000 0000 0000 0000 c0c0 c0c0 c000 0000
0860 0000 0000 0000 0f0f 0f0f 0f0f 0f00 0000
0870 0000 0000 00e0 e0e0 e0e0 e0e0 0000 0000
0880 0000 001f 1f1f 1f1f 1f1f 1f1f 0000 0000
0890 0000 f0f0 f0f0 f0f0 f0f0 f0f0 f0f0 0000
0900 3f3f 3f3f 3f3f 3f3f 3f3f 3f3f 3f00 0000 00f8
0910 8ff8 8ff8 8ff8 8ff8 8ff8 8ff8 0000 007f 7f7f
0920 7f7f 7f7f 7f7f 7f7f 7f7f 7f7f 0000 fcfc fcfc
0930 0000 0000 0000 0000 0000 0000 0000 0000
0940 b4e9 61d4

```

'660 KONG

This simplified version of a popular arcade game has two levels of play and features simple animated graphics. The object is to make your way to the top left-hand corner of the screen and jump over the barrier to rescue the damsel in distress.

To run right, press '3' and to run left, press '1'. To climb a ladder, you must first position yourself to the left of the ladder, facing it. Pressing '2' will then start you climbing (hold it down to continue up and hop on to the next floor), but there is no turning back! Three barrels are continuously rolled down the floors and ladders and you must jump these by pressing '0'. As you will discover, the barrels are not the only hazards!

At the end of each attempt to reach the damsel, your cumulative score is displayed, based on the floor reached and the time elapsed since starting that attempt (the less the better). After three attempts, the path becomes even more hazardous and you have another three attempts.

Appropriate sound effects are included — you should recognize the tunes! The game is in colour, so it takes a few moments for the display to come up. Pressing '8' will start a new game.

Tim Parish, Myrtle Bank SA

THIS COLUMN is for those readers who own a small microcomputer system that runs the "CHIP-8" language. This was developed for 8-chip "trainer" micro systems, such as the RCA VIP (VP-111) system, Michael Bauer's 'Dream' and the ETI-660 Learner's Microcomputer (published in 1981).

A useful little newsletter for hobbyists running a CHIP-8 system is compiled, published and distributed by Frank Rees, 27 King St, Bootle Vic 3537.

We have been asked for hardware mods and expansions for the '660, such as full ASCII keyboard, BASIC, 32K RAM etc. As you can now buy a whole computer for less than such expansion of the '660 would cost, there's not much point. However, we have a couple of interesting things in the pipeline ...

LISTING :

```

0600 f055 a990 f155 2a14 6b02 6c26 6d00 6e0c
0610 6a00 a8fe d0c8 a91e 6039 6103 d01b 6720
0620 6007 a95e da07 00ee fe02 0002 0002 0002
0630 0002 0002 0002 3030 1078 1010 2824 3030
0640 0f00 102a 4420 1818 103c 10a8 4408 1818
0650 103c 1010 2848 1818 5438 12fe 8000 3030
0660 1030 5010 1030 3030 2030 2820 2030 1c2c
0670 3c3c 9cfc 7c1c 1c38 78ff 3854 9292 9254
0680 3838 44a2 928a 4438 3844 82fe 8244 3838
0690 448a 92a2 4438 1818 101c 1018 0400 1818
0700 1418 1010 0804 3030 5438 90fe 0200 c1c1
0710 81e1 8181 c110 d1ff 088b ff28 aa54 aa54
0720 aa54 aa54 aa07 00ff a990 f165 7101 3108
0730 198a 6100 7001 4064 1a6c a990 f155 16da
0740 0000 0000 0000 0000 0000 0000 0000 0000
0750 0000 0000 0000 0000 0000 0000 0000 0000
0760 0000 0000 0000 0000 0000 0000 0000 0000
0770 0000 0000 0000 0000 0000 0000 0000 0000
0780 0000 0000 0000 0000 0000 0000 0000 0000
0790 0000 0000 0000 0000 0000 0000 0000 0000
0800 0000 0000 0000 0000 0000 0000 0000 0000
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0990 0000 0000 0000 0000 0000 0000 0000 0000
1000 0000 0000 0000 0000 0000 0000 0000 0000
1010 0000 0000 0000 0000 0000 0000 0000 0000
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1090 0000 0000 0000 0000 0000 0000 0000 0000
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1110 0000 0000 0000 0000 0000 0000 0000 0000
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2460 0000 0000 0000 0000 0000 0000 0000 0000
2470 0000 0000 0000 0000 0000 0000 0000 0000
2480 0000 0000 0000 0000 0000 0000 0000 0000
2490 0000 0000 0000 0000 0000 0000 0000 0000
2500 0000 0000 0000 0000 0000 0000 0000 0000
2510 0000 0000 0000 0000 0000 0000 0000 0000
2520 0000 0000 0000 
```

3D MAZE

Peter Easdown, Kew NSW

This program is a three dimensional maze game for the hires screen, but can only be used on a '660' which has been modified to obtain a 64 x 64 pixel display. See Bill Kreykes article 'Experimenter's modifications to the '660' in ETI, February 1984.

The aim is to collect as many treasures as possible and make your way to the exit. When the program is run it displays a title page and asks you to press key '1'. The keys are then displayed with a description of what they do. A more detailed description of the keys is:

Key '8' will move you forward one step in the direction you are facing.

Key '4' will turn you around on the spot in 90° intervals to the left.

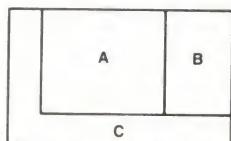
Key '6' will turn you around on the spot in 90° intervals to the right.

Key '2' will turn you around in a 180° arc so that you now face the directly opposite direction.

Key 'A' will show your position on the map which is conveniently on the screen at all times. This help call can only be attained once. Just press key 'A' again to get out of this mode.

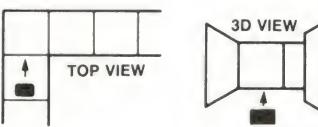
Key 'F' will quit the game, but first it will ask 'SURE?'. If you do intend to quit just press 'F' again, otherwise press any other key.

The screen is divided into three main sections, A, B and C. A is where you look to see the 3D representation of where you are. B is the map of the maze with the exit at the top of the screen. C is the message area.



Screen layout. Diagram out of scale.

When playing there are always four treasures somewhere in the maze. When you come across one a box will appear on the ground (in the 3D picture) and the word 'TREASURE' will flash across the bottom of the screen. To take the treasure simply press Key 'D'.



In these diagrams you are looking in the direction of the arrow from the point marked by the black box.

There is always one dud treasure in the maze; although all treasures have some magical property, the dud has the worst. When you take a dud, (you don't know it's a dud until you do) the words 'DUD TREASURE' will flash across the bottom of the screen and all of your treasures, including the dud, disappear and reappear elsewhere in the maze. The magical properties of the other treasures aren't as bad; sometimes they will just turn you around.

The routines that draw the 3D images are located from 0616-071C and from 0F10-0F62. These routines simply plot lines to make parts of the images.

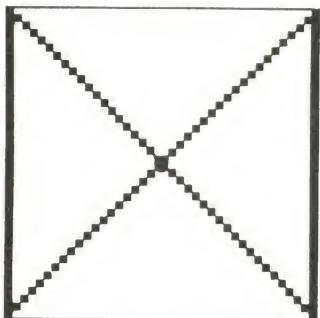
The map is not really there to help you; it's the key to working out what type of room you are in. The routine located at 086A-0974 and 0F64-0FF8 plots small shapes on the map at your location to work out what type of picture to draw; it is then drawn by doing the appropriate picture routines. Unfortunately, by using this method you can usually see where you are.

As the program needed utmost speed and the map was needed at all times I couldn't afford to clear the

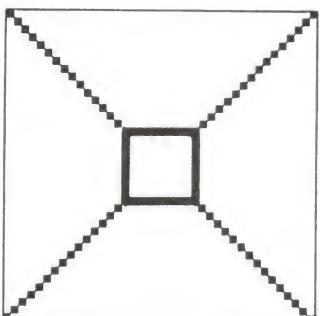
whole screen for each move, so I wrote a MCSR to clear just the picture section of the screen. I have supplied a disassembled listing for those who understand the 1802 instruction set. With minor changes it could be made to clear any portion of the screen, or even to fill portions of the screen.

When playing the game the picture could be a bit misleading. When you come to a junction of any type you will first see it from a distance. Remember, you may not turn immediately down the other passage, you must first go forward to the junction then turn to face the way you wish to go.

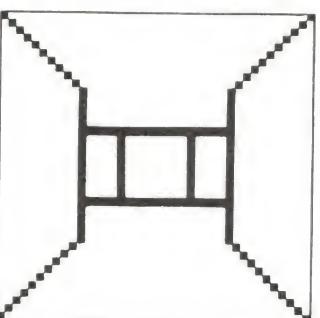
Due to the length of the program I will copy it onto a tape for anyone who is interested. Just send your name and address to **Peter Easdown, c/- Post Office, Kew NSW 2439** with \$6 which covers postage and the cost of a good quality tape.



No junction. Passage just leads on.



Dead end.



Junction. Turns left and right.

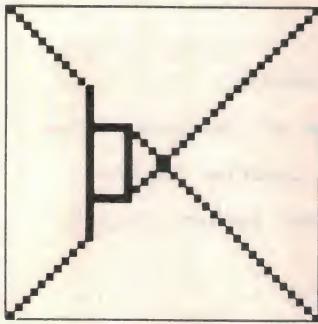
3D MAZE

```

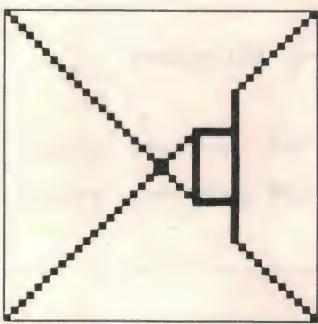
600 1D3C 6100 A85B 6005 D011 00FF 00FF 7101
610 3128 1606 1BC6 610F A85B 6014 D011 601D
620 D011 7101 3119 161A 6015 610F D011 6118
630 D011 7001 3013 162A 00EE 6006 6101 652B
640 A85B D011 D511 7001 7101 75FF 310F 1642
650 6006 6126 652B D011 D511 7001 71FF 75FF
660 3118 1656 00EE 6014 A64D F055 6013 A661
670 F055 263A 600F A64D F055 6018 A661 F055
680 00EE 600F 610A A85B D011 7101 311E 1688
690 6010 610F 6518 D011 D051 7001 3014 1696
6A0 00EE 602B 6101 6526 A85B D011 D051 70FF
6B0 7101 75FF 301D 16AA 6006 6101 6526 D011
6C0 D051 7001 7101 75FF 300F 16BE 00EE 6022
6D0 610A A85B D011 7101 311E 16D4 601E 610F
6E0 6518 D011 D051 7001 3022 16B2 00EE 6006
6F0 6101 6526 A85B D011 D051 7001 7101 75FF
700 3014 16F6 602B 6101 6526 D011 D051 70FF
710 7101 75FF 3022 170A 00EE 26B8 1704 F804
720 BEF8 81AE F800 5E1E 8EFA 0FFF 0532 388E
730 FAOF FF0D 3238 3024 1E1E 1E1E 9EFF 053A
740 248E FAOF FF01 3A24 8EFA F0FF C03A 24F8
750 04BE F880 AEOE FAFC 5E1E 1E1E 0EFA
760 0F5E 1E1E 1E9E FF05 3A55 8EFA F0FF C03A
770 55D4 FFFF F007 FFFF 8FF8 F800 FFFF 00DF
780 08DF FF01 7F77 7741 5D5D 5DDD D11F FFO3
790 7B0D 0D0D 0DOC 0FOE 0EOE 0EOF 0FOF 0FOF
7A0 DFC0 F7F7 37F0 F7FF FFO0 7D7D 455D 5D7B
7B0 1FBF FFFF 1FDF C3DF 1FFB FBF8 03DF 0FOF
7C0 0FOF 0FOC 0FOC 0FOF 417F 7F00 7777 F007
7D0 FCFF DFC3 DB1B FBFB 3BFB 03FF 6028 6100
7E0 A976 D01F A773 7008 D01F 7008 A782 D01F
7F0 710F A7AF D01F 70F8 A7AO D01F 70F8 A791
800 D01F 710F A7BE D01A 7008 A7C8 D01A 7008
810 A7D2 D01A 0DEE 1F23 45F9 8A8C F800 COOF
820 702D C11F A9D2 D011 3F00 1985 1C5C 281E
830 8700 8810 00EE 281E 8900 8A10 00EE 281E
840 8B00 8C10 00EE 281E 8D00 8E10 00EE 6013
850 611F A816 D017 00EE C040 C080 40C0 80C0
860 E040 40E0 40C0 4080 C080 4600 18D6 4601
870 1912 4602 1944 8020 8130 70FF 71FF A867
880 D013 3F01 18C6 D013 1FD2 D012 3F01 18CA
890 D012 7101 A85A D012 3F01 18CE D012 A85E
8A0 D011 3F01 18D2 D011 2616 163A 00FF 2616
8B0 198A 00FF 2616 26EE 16CE 00FF 2616 26A2
8C0 1682 00FF 1666 D013 18AC D012 18B2 D012
8D0 18BA D011 18C2 8020 8130 70FF 71FF A860
8E0 D012 3F01 190E D012 1F64 D012 3F01 18CE
8F0 D012 7001 A85A D012 3F01 18CA D012 A85E
900 D011 3F00 18A6 18D2 00FF D011 1602 D012
910 18AC 8020 8130 71FF A864 D013 3F01 18C6
920 D013 1F8E D012 3F01 18CE D012 7101 A858
930 D012 3F01 18CA D012 7001 A85E D011 4F01
940 18A6 18D2 8020 8130 70FF A862 D012 3F01
950 190E D012 1FB2 D012 3F01 18CA D012 7001
960 A85E D012 3F01 18CE D012 A85E 7101 D011

```

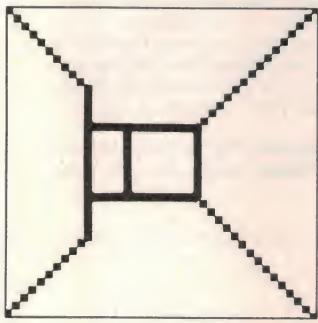
CHIP 8 COLUMN



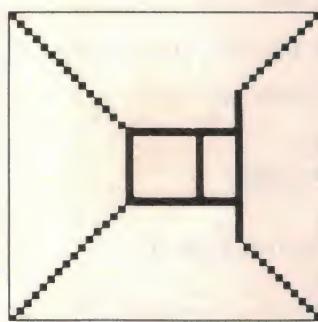
Junction. Turns left and leads on.



Junction. Turns right and leads on.



Junction. Turns to the left.



Junction. Turns to the right.

970	4F01	18A6	18D2	ODOD	OCOD	ODOD	ODOD	ODOD	CBO	F029	D675	7604	F129	D675	7604	F229	D675
980	ODOC	ODOD	ODDO	1118	1E31	271A	2682	16CE	CCO	6600	7706	2A2C	6706	6620	AA10	29C0	2A20
990	5270	1998	9380	1B60	5290	19A0	93A0	1B60	CDO	0000	E79F	06DD	88A8	2A22	BFDA	F7DB	E54F
9A0	52B0	19A8	93C0	1B60	52D0	00EE	93E0	1B60	CEO	F3CF	F7DB	E92E	BFDA	0820	0000	F24F	F6DF
9B0	00EE	0F13	3801	E018	0335	A9B2	F755	00EE	CFO	924F	924F	F3CF	F24F	E925	0000	F7DB	924F
9C0	F165	A9F8	8200	8310	64E0	6580	29F2	8020	DOO	924F	E925	F7EB	F3CF	F7DB	711D	B6DE	F7EB
9D0	29EC	8020	8004	8152	3100	7001	29E8	8030	D10	E3CF	711D	F7DB	F6DA	D6DD	F3CF	711D	F24F
9E0	29F0	8030	29EA	1A62	8004	8004	8004	8004	D20	F7DB	F7C8	F3CF	0003	F7C8	F7EB	F3CF	711D
9F0	8004	8042	F055	DOEE	6080	4020	COAO	F7DB	D30	711D	0000	9000	9248	9000	0003	6610	6700
A00	D6DD	F3CF	B7DA	B75A	924F	F6DF	F7C8	F7EB	D40	6800	ACD2	F81E	29C0	2A20	7802	3810	1D42
A10	711D	E925	B6DE	B7A5	E789	4905	0003	0028	D50	770C	6600	ACD2	F81E	29C0	2A20	7802	3830
A20	D675	7604	00EE	29BA	6610	672B	AA12	29C0	D60	1D54	7706	6614	ACD2	F81E	29C0	2A20	7802
A30	2A20	AAOE	29C0	2A20	AA02	29C0	2A20	A9FE	D70	3842	1D66	7706	6614	ACD2	F81E	29C0	2A20
A40	29C0	2A20	AA10	29C0	2A20	AA14	29C0	2A20	D80	7802	3848	1D78	7604	ACD2	F81E	29C0	2A20
A50	AAOE	29C0	2A20	AA02	29C0	2A20	A9B2	F765	D90	7802	3856	1D88	770C	660C	ACD2	F81E	29C0
A60	00EE	A9F8	00EE	29BA	6600	672B	AA0A	29C0	DAO	2A20	7802	386A	1D9A	FOOA	3001	1DA8	00E0
A70	2A20	AA06	29C0	2A20	AA1C	1A58	29BA	6600	DB0	6618	6700	6800	2E3C	29C0	2A20	7802	3808
A80	672B	AA00	29C0	2A20	AA14	29C0	2A20	AA00	DC0	1DB6	7706	6600	2E3C	29C0	2A20	7802	3828
A90	29C0	2A20	7604	1A2C	29BA	6610	6700	AA10	DD0	1DC6	7706	6600	2E3C	29C0	2A20	7802	3842
AA0	29C0	2A20	AA14	29C0	2A20	AA0E	29C0	2A20	DE0	1DD6	6600	7706	2E3C	29C0	2A20	7802	3858
AB0	AA02	29C0	2A20	AA18	1A58	29BA	6600	672B	DFO	1DE6	7706	6600	2E3C	29C0	2A20	7802	3878
AC0	1A16	29C0	2A20	AA0A	29C0	2A20	AA14	29C0	E00	1DF6	7706	6600	2E3C	29C0	2A20	7802	3898
AD0	2A20	7604	A9FE	29C0	2A20	AACE	29C0	2A20	E10	1E06	7706	6600	2E3C	29C0	2A20	7802	3888
AE0	AA02	29C0	2A20	7604	AA04	29C0	2A20	AA02	E20	1E16	7706	6600	2E3C	29C0	2A20	7802	38C8
AF0	29C0	2A20	AAOE	29C0	2A20	AA02	29C0	2A20	E30	1E26	F00A	3001	1E32	00E0	1602	A4E2	F81E
BO0	AA1A	1A58	29BA	6600	672B	AA10	29C0	2A20	E40	00EE	B75A	F3CF	B7A5	711D	F7DF	0820	0000
BI0	AAOC	29C0	2A20	AA08	29C0	2A20	A9FE	29C0	E50	BFDA	F6DF	B6D5	F3CF	0000	F349	F6DF	F7EB
BJ0	2A20	AA12	29C0	2A20	1B00	6000	610A	AF00	E60	B7FA	F7DB	F7EB	D6DD	0003	96F3	0820	0000
BJ0	F11E	F055	7101	3110	1B2E	1B2B	AFOA	F065	E70	E925	B6DE	F7EB	F6DA	0000	924F	F3CF	F349
BJ0	3000	00EE	6001	2C60	2ABA	A9DE	D231	F200	E80	E925	0003	F3DF	0820	0000	E925	B6DE	F7EB
BJ0	F218	D231	600A	E0A1	1B5C	1B4C	2ABA	00EE	E90	F6DA	0000	F7EB	E92E	F2DF	B7DA	E925	0003
BJ0	2A26	284E	1A26	F055	2A7C	00EE	5270	1B74	EAO	E7CF	0820	0000	E925	B6DE	F7EB	F6DA	0000
BJ0	9380	1B18	5290	1B7C	93A0	1B2A	52B0	1B84	EBO	4925	F7DF	F6DF	F780	0003	F7DB	0820	0000
BJ0	93C0	1B19	52D0	00EE	53E0	00EE	284E	2846	EBO	711D	B7DA	F6DF	B7FA	0000	924F	F6DF	F24F
BJ0	AFOB	F065	7001	AFOB	F055	00EE	284E	283E	EBO	F7DB	E925						

CLEAR SCREEN ROUTINE

71E	LDI	04	F804						75E	LDN	E	OE
720	PHI	E	BE	736	BR	24	3024	74B	75F	ANI	07	FA07
721	LDI	81	F881	738	INC	E	1E	74D	761	STR	E	5E
723	PLO	E	AE	739	INC	E	1E	74F	762	INC	E	1E
724	LDI	00	F804	73A	INC	E	1E	751	763	INC	E	1E
726	STR	E	5E	73B	INC	E	1E	752	764	INC	E	1E
727	INC	E	1E	73C	GHI	E	9E	754	765	GHI	E	9E
728	GLO	E	8E	73D	SMI	05	FF05	755	766	SMI	05	FF05
729	ANI	OF	FAOF	73F	BNZ	24	3A24	756	768	BNZ	55	3A55
72B	SMI	05	FF05	741	GLO	E	8E	758	76A	GLO	E	8E
72D	BZ	38	3238	742	ANI	OF	FAOF	759	76B	ANI	FO	FAFO
72F	GLO	E	8E	744	SMI	01	FF01	75A	76D	SMI	CO	FFCO
730	ANI	OF	FAOF	746	BNZ	24	3A24	75B	76F	BNZ	55	3A55
732	SMI	0D	FF0D	748	GLO	E	8E	75C	771	SEP	04	D4
734	BZ	38	3238	749	ANI	FO	FAFO	75D				(RETURN)

LINE INPUT

P. Lukes, Toowoomba Qld

The MicroWorld INPUT function is rather limited. It will not accept embedded commas or quotes, and worse still, it accepts the codes for ESC and TAB without any visual indication. This applies both to string and numeric input. For INPUT K, enter '1 TAB 2', and the result will be '182'. A string can have these codes unknowingly embedded in it and then fail a test for equality or length.

The following routine can avoid these problems. The I0\$ is a dummy, which is not used for further processing. L0\$ is the correct input, and it is assembled by taking the valid characters directly from the I/O buffer starting at 1832 dec., and terminated when Carriage Return is encountered. In a running program it would be advisable to set the dummy to null immediately after input (INPUT I0\$:I0\$=""), to avoid cluttering up the string space.

Once the normally prohibited quotes and commas are in the string, there is no problem with further processing and the string can be printed to tape or printer. It can be re-INPUT from tape by using the same procedure.

The assembly of long strings takes some time, but the routine could be speeded up by compressing it or coding it in machine language. The KEY function could be used to accept any valid keyboard input, but it would not work with tape input.

```
01000 CLS:PRINT"MicroBee 'LINEINPUT' LKS 840314"
01010 I0$=""REM In case of unpaired quotes
01020 B=1832:L=184:REM B=I/O buffer start, L=buffer length
01030 PRINT"INPUT string with leading spaces, commas, quotes :"
      'INPUT I0$
01040 PRINT:L0$="":FOR A=B TO B+L:K=PEEK(A)
01050 IF K=13 THEN NEXT A 1090:REM Exit on CR
01060 IF K>96 AND K<123 THEN LET K=K AND 95
      'REM Convert letters to upper case (optional)
01070 IF K>31 THEN LET L0$=L0$+CHR$(K)
      'REM Assemble lineinput without control characters
01080 NEXT A
01090 PRINT"INPUT :"      TAB(20) CHR$(190) I0$ CHR$(188) LEN(I0)
01100 PRINT"LINEINPUT :" TAB(20) CHR$(190) L0$ CHR$(188) LEN(L0)
01110 GOTO 1030
```

BANNER

M. Anderson, Perth WA

The program uses the PCG RAM to print a one line message by testing the bits of the first, second, third, etc, bytes of all the characters in the message, and printing that character if the respective bit is set.

Using the PCG RAM instead of the character ROM means that you can print your own oversized PCG characters by making the modifications described (as is, the program is configured to invert inverse characters).

With a bit of ingenuity, I managed to print a poster size picture of the man in the 'Roulette' game, (Microbee demo cassette) by running 'Roulette' to setup the PCG, and then BANNER to print the relevant characters (encl.). To print preceding spaces you will need to put your message in quotation marks.

The Z80 code subroutine (RBIT) is poked from the DATA in line 230 and simply rotates each byte to test the next bit.

```
00100 REM BANNER B-I-G Printing for little printers !
00110 REM      - by MJ Anderson
00120 REM      The USR function in line 220 assumes the pcg chrs are
00130 REM      initialised to INVERSE. To print large PCG chrs., change
00140 REM      the IF USR(7000) statement in line 220 to IF NOT USR(7000)
00150 REM      and to print control chrs., change the CHR(L) to "*"
00160 PRMT( ):INPUT "Output to device#";D:OUTL#D:CLS
00170 IF D=0: M=64 ELSE LET M=80 :REM # chrs/line, 64 for VDU, 80 for others
00180 M=M/B:FOR I=7000 TO 7018:READ J:POKE I,J:NEXT I
00190 CURS 0:INPUT "MESSAGE ";M0$:IF LEN(M0$)M:PLAY1:GOTO 190
00200 FOR I=0 TO 15:FOR J=1 TO LEN(M0$)
00210 L=ASC(M0$(J,J)):P=63488+J*16+I:POKE 7018,PEEK(P)
00220 FOR K=0 TO 7:IF USR(7000)$LPRINT " "; ELSE LPRINT CHR(L);
00230 NEXT K:NEXT J:IF LEN(M0$)(M:LPRINT
00240 NEXT I:LPRINT:GOTO 190
00250 DATA 58,105,27,203,23,50,105,27,48,4,1,255,255,201,1,0,0,201,0
```

BOOK REVIEW

Wildcards, Volume Two, by Peter Ford, Ash Nallawalla and Bob Burt; published in 1983 by BF & N Publishing, P.O. Box 85, Williamstown Vic. 3016.

Wildcards, Volume Two

Tom Moffat, Fern Tree, Tasmania

Wildcards, Volume Two, is a follow-on from the original *Wildcards* (obviously); a collection of tips and tricks for the Microbee, combined with some solid instruction in programming, both in BASIC and machine code.

It's just as good as the first volume, although not quite as 'startling' — the first *Wildcards* hit like a bombshell, giving the MicroBee user a much needed dose of instruction where virtually nothing existed before.

Wildcards, Volume Two, now has the unenviable task of following its own act. But the authors have launched into the task and produced another winner.

Starting off the new book are a few machine code routines just to whet the Microbee user's appetite. One I tried was a routine to make the screen dissolve away to all spaces (blanks), with each displayed character decrementing down to the finish.

The effect is dramatic, as the book claims, but it looks suspiciously like my screen does when the computer crashes. So I don't think I'll be using the effect as a permanent feature in my programs — it's too scary! There are also some routines to scroll the screen left and right.

After a few 'hints and kinks' *Wildcards, Volume Two*, gets into its main instructional feature — a good discussion of sorts and shuffles. It uses a series of BASIC programs to demonstrate how various types of sorts work, with most of the action taking place on the screen so you can see what's happening.

I tried out the first program, and it worked straight off. It takes a random series of numbers and puts them in order. When the program runs, the list of numbers appears in a vertical line down the centre of the screen, with a message off to the side saying 'Sorting...'. The numbers then begin to change position before your very eyes! But seriously, it's a good demonstration of how the sort works, with the column of numbers eventually ending up in order.

The chapter progresses through string sorts, exchange sorts, shell sorts, to a quick sort. They all start with the first program and modify or build on it, saving the instructee a lot of typing.

The chapter finishes with a couple of shuffles, which are really sorts in reverse. One thing missing, I feel, is a discussion of searches in the same chapter.



Without even asking we received two reviews of this book. Tom Moffat, in Tasmania, and Mike Hennessy, in Papua New Guinea, have given us their opinions — now you can make up your mind about this book.

It seems they should all go together, somehow. Maybe in the next volume.

The 'Applications' chapter presents several 'useful' as compared to 'demonstration' programs. Among them are routines to convert Microbee BASIC programs to and from NOS-BASICODE. This

Wildcards, Volume Two

Mike Hennessy, Lae, Papua New Guinea

The authors claim the book is a potpourri of application notes and tips for the Microbee personal computer, and it is just that.

This volume has fallen together in a better organised fashion than Volume One, which was obviously a rush job. The quality of the printing is also far superior to the earlier volume.

Nine chapters are presented; some are tantalisingly short e.g. machine language, and some are laboriously long, e.g. sorts and shuffles. There is less of a tendency to scatter short routines throughout the book, and 39 programs are listed in the rear index to keep you busy for a very long time.

The best part for the machine language buffs is the extensive memory map of the Microbee in the appendix. The section of sorts and shuffles became a bit involved. The routines presented were all well known as algorithms, e.g. shell sort, shuttle interchange, the differences being that they have been coded in Microworld BASIC and machine language, and applied in suitable demonstration programs i.e. Card Shuffle.

In the chapter on applications an excellent sound

is a kind of computer Esperanto cooked up by the international shortwave broadcaster "Radio Nederland" for transmission of programs to the world's masses.

Wildcards' authors propose that the standard could be used to exchange cassette programs between Microbees and, say, TRS-80s or Ataris. Sounds like a good idea.

Wildcards, Volume Two, has a good strong chapter on graphics, with an interesting feature being the use of recursion; that is, using routines that can call themselves. This is really heavy stuff if you think about it — much like the snake that chews its tail until it eats itself.

Recursion is a much used technique in the LOGO language. I tried it once on the 'Bee under FORTH and it went into such a bad crash that the memory battery had to be disconnected to restore it to sanity. It will be interesting to see how it works in the *Wildcards* programs.

There are many more goodies in *Wildcards, Volume Two*, that are too numerous to mention here, but you seem to get plenty for your \$16; a dollar more than Volume One. Apparently a Volume Three is in the works as well — here's hoping it's as informative as the first two.

generator program is presented that should enable you to produce a range of sound effects for your programs. Other applications include a spread sheet and data base — all lengthy programs but worthy of the effort of keying them in.

The utilities chapter is far too brief, the most useful listings being the screen dumps for the C-Itho 8510A and Star DP-510 printers. Nothing new was presented in the chapter on graphics, although some good demonstration programs using recursive plotting were presented.

There is a fair section on conversion between Microworld and other BASICs, with several pages devoted to NOS-BASICODE that tended to become a bit esoteric. This appeared to be a pet hobby horse of one of the authors.

What's missing? Well, there is nothing on the use of colour; and disk drives, modems, light pens and other peripherals receive only a passing mention.

I received the impression the authors were struggling to fill this volume and my suspicions were confirmed when I discovered the questionnaire and the plea for program submissions at the end of the book.

At \$16 I thought the book expensive but a must for Microbee enthusiasts. If there is a *Wildcards* Volume Three my suggestion is that it be accompanied, as an option, by a cassette of the programs in the book.

DYNAMIC PCG DISPLAY

H. Beilharz, Kareela, NSW

This little program allows you to see the programmable character generator (PCG) working while a program is running. I have found it invaluable for debugging graphics programs.

Lines 100 to 140 change the start of screen pointer in the 6545 VDU chip so that we shift the screen by two lines, i.e. we lose the top two lines of the normal screen and insert two new lines at the bottom. This

means that the bottom two lines will not be affected by scrolling or clear screen (CLS). The main disadvantage is that we miss what is happening on the top two lines of the normal screen. This is no problem with the BASIC prompt, just press Return twice to move the prompt down. The real problem is that error messages usually appear on these two top lines, still we can't have everything can we?

Lines 150 to 170 poke characters 128 to 255 into the two new lines.

Type in the program, then RUN it. Now it can be deleted as the screen will stay set up until RESET

(warm start). Now to test, type INVERSE then UNDERLINE then LORES and watch the character set change. Now load any program that uses HIRES graphics to really see the PCG in action.

```

100 DATA 120,211,12,121,211,13,201
110 FOR A=0 TO 6
120 READ I:POKE 63000+A,I
130 NEXT A
140 USR(63000,3456)
150 FOR A=0 TO 127
160 POKE 62464+A,128+A
170 NEXT A:END

```

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32K Personal Communicator \$499

microbee's top selling portable computer now features:

Telcom 1 firmware WORDBEE, Microworld BASIC, machine code MONITOR, ADM-3A terminal emulation, self-test in 28K of ROM with 32K of CMOS battery backed user memory, high resolution PCG GRAPHICS, SERIAL AND PARALLEL I/O ports, programmable cassette interface and direct monochrome video output.

A vast library of educational, entertainment and utility software is now widely available.

Microworld BASIC supports full high resolution graphics, colour if required, music, I/O data can be directed at will and best of all, MW BASIC is a breeze to program yourself.

The low cost

BEEMODEM can be added enabling your **microbee** (via your phone line) to communicate with other computers worldwide!

Software and your **microbee**

Whichever **microbee** model you choose there is a vast and growing array of software to use with it . . . some built-in and included in the price of your computer. Games and family entertainment, education programmes, communication, information systems, personal and business finance, word processing and much, much more.

Ask at your **microbee** Computer Centre for the current range of software included with each model or ask for the catalogue of "Software Available".

Options and Peripherals

Advanced "State of the Art" peripherals and options are available to interface with your **microbee** such as:

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Adjustable Monitor Stand . . .	\$19.95
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(Includes cables)	
microbee High Resolution Anti Glare	
Ergonomically Designed	
Amber Screen Monitor . . .	\$249.00

Now with Dynamic RAM to meet today's user demands

64K Advanced Personal Computer

(with Single 400K Disk Drive \$1,595 and all manuals)

The **microbee 64K Advanced Personal Computer** with a Single 400K Disk Drive is the ultimate configuration for the serious enthusiast.

It is supplied 'bundled' with world class software such as CP/M, MICROSOFT BASIC, MULTIPLEX, WORDSTAR and a powerful library of support programs. Comprehensive user manuals are also supplied. No wonder this model **microbee** is regarded as the most powerful and best price/performance computer in its class.

microbee 128K

(with Dual 400K Disk Drives \$1,995 and all manuals)

Designed for the serious home and small business user, the package consists of the **microbee** with 128K of dynamic RAM controlled by the proven Z80A processor plus a dual 400K disk drive, with the increased power more sophisticated programs can be executed including a whole host of bundled software for word processing, terminal emulation and communication with other computers worldwide, spreadsheet analysis and networking.



microbee 128K Computer with Dual Disk Drive

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LANDER

M. Spiteri, Seaford Victoria

Another version of those perennial lander programs that exercise the minds of computer users from six to sixty.

This one features user definable graphics and uses the keyboard (A,W,D,X) to control the craft. Fuel is divided into 45 units.

```

4 PRINT"PLEASE WAIT....."
10 GOSUB1000
20 POK36879,8:PRINT"     SUPER LANDER"
21 PRINT"R ====="
30 PRINT"YOU HAVE TO LAND YOUR" PRINT"SPACECRAFT
INTO THE"
35 PRINT"LANDING SPOT.":PRINT"YOU HAVE 45 FUEL TANKS"
40 PRINT"WHICH RUN OUT QUICKLY.":PRINT"YOU HAVE
TO BE FAST"
45 PRINT"WHICH HIT A KEY...."
50 GETA$:IF A$="THEN50"
55 PRINT"GAME ENDS WHEN EITHER:";I"
60 PRINT"21) YOU LAND."
65 PRINT"22) YOU CRASH."
70 PRINT"23) YOU RUN OUT OF FUEL"
80 PRINT"CONTROLS:"
85 PRINT"UP:DOWN: X:DOWN"
86 PRINT"LEFT: D:RIGHT"
87 PRINT"WHICH HIT A KEY TO START!"
88 GETA$:IF A$="THEN88"
90 POK36878,15:POKE36877,190
100 POK36879,8:PRINT"J: FU=45
110 FORA=8054T08185:POKER,1:NEXT:FORB=38774T038905:
POKEB,2:NEXT
120 FORB=8032T08039:POKER,2:NEXT:FORB=38752T038759:
POKEB,2:NEXT
130 FORA=8043T08053:POKER,2:NEXT:FORB=38753T038773:
POKEB,2:NEXT
140 POK36878,3:POKE37860,2:POKE36876,4:POKE37862,2:
POKE36841,5:POKE37861,1:P=7747
150 CO=30720
160 PRINT"REFUEL ?":FU:FU=FU-1
161 IFFU=0THENFORI=255T0190STEP-1:POKE36876,I:NEXT:GOT0348
170 IFFUC15THENPRINT"REFUEL ?":PRINT"REFUEL SHORTAGE!":
PRINT"REFUEL ?":POKE36876,190
180 POKEP+CO,5:POKEP,6
190 GETA$:
200 IF A$<>"W"ANDA$<>"A"ANDA$<>"X"ANDA$<>"D"THEN160
210 POKEP,32
220 P=P+(A$="R")-(A$="D")
230 P=P+(A$="W")*22-((A$="X")*22)
240 IFF=0041THENFORI=190T0255:POKE36876,I:NEXT:POKE36877,0
POKE36878,0:GOT0270
250 IFF=0031THENFORI=255T0190STEP-1:POKE36876,I:NEXT:
POKE36877,0:POKE36876,0:GOT 0300
260 GOT0150
270 POK36879,25:PRINT" WELL DONE!!":PRINT"YOU
LANDED SAFELY!!"
280 PRINT"REFUEL LEFT :":FU:GOT0400
300 FORI=0T0255STEP4:POKE36879,I:NEXT:POKE36879,25
305 PRINT"GAME OVER"
310 PRINT"YOU RECKLESS PILOT!"
320 PRINT"YOU CRASHED!":GOT0400
340 FUR=0T0255STEP4:POKE36879,I:NEXT:POKE36879,25
345 PRINT"GAME OVER"
350 PRINT"YOU ENERGY WASTER!":PRINT"YOU RAN OUT OF
FUEL!":GOT0400
360 PRINT
400 POK36878,0:POKE36877,0:POKE36876,0:PRINT"ANOTHER
410 GETA$:IF A$<>"Y"THEN40:IF A$="N"THEN410
420 IFF$="Y":THEN20
430 PRINT"GOODBYE!"
435 GOT0435
440 POK36878,28:POKE56,28
4405 FORT=7168T07679:POKEI,PEEKI+256001:NEXT:POKE36869,25
4410 FORJ=7167T07237:REHDX:POKEZ,X:NEXT:RETURN
4420 DHTH255,191,251,255,223,255,247,255
4430 DHTH32,98,247,255,247,223,251,255
4440 DHTH19,192,244,246,184,236,190,255
4450 DHTH13,17,13,31,55,125,255
4460 DHTH6,10,10,125,24,24,24
4470 DHTH4,8,4,69,165,255,219,255,55

```

READY

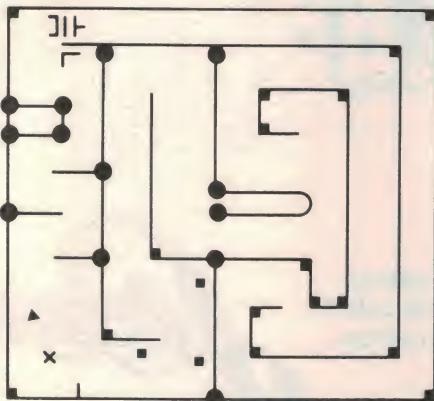
READ

DRIVING TEST

◀ Steven Komninos

VIC 20

This program utilizes the graphics capacity of the VIC-20 to set up a driving test for your edification and delight. Although it looks easy, the originator claims never to have got to the end.



MESSAGE INVERTER

Keith Zerna,
Modbury Heights,
SA.

VIC 20

This program will print your message on-screen upside down! While, at face value, the program is seemingly useless, it is a bit of fun and good for learning about the PEEK and POKE commands.

When entering the program, you enter your message at line 140 in the PRINT statement. You cannot use numbers, only letters. When run, your message will appear on the screen with all the letters upside down.

```

50 A=7175
60 R=0
70 FORT=RTOA-7STEP-1 R=R+1
80 X(R)=PEEK(T+25600)
90 NEXT
100 R=0
110 FORT=A-7TOM R=R+1 POKE T,X(R) NEXT
120 IF A>7672 THEN H=A+8:GOTO 60
130 PRINT"J1";
140 PRINT"SKIPSIDE DOWN LETTERS!!!!"
150 PRINT"";
160 POKE36868,255 FORT=1T0150
170 GOSUB220 NEXT
180 POKE36868,240
190 FORT=1T0150
200 GOSUB220 NEXT
210 GOTO150
220 GET#4 IF A#="" THEN240
240 IF A#="" THENRETURN
250 GOTO220

```

READY

BOOK REVIEW

Using the 64 by Peter Gerrard; published by Duckworth, UK; distributed by ANZ Book Co, 10 Aquatic Drive, Frenchs Forest NSW 2086; Rp \$29.95.



Peter Gerrard, former editor of *Commodore Computing International*, is the author of two top-selling adventure games for the Commodore 64 and a regular contributor to several magazines.

The preface of *Using the 64* states that the book is designed for those who would like to do a little more with their Commodore 64 than draw pretty pictures on the screen, or make it speak to them in a collection of weird and wonderful beeps and burbles.

The book certainly does show the reader how to do these things but the information, with many examples of programs to illustrate points and features, will help the reader to go further in exploring the Commodore 64. In fact, I would go as far as to describe this excellent book as the Commodore User's Bible.

Gerrard commences with a swift gallop through the BASIC language. He started with the absolute basics of the Commodore 64, introducing the keyboard and describing the functions of the special keys, e.g. the RUN/STOP and RETURN keys. The basics are very well explained and the most complex part of the language is expressed in such simple and explicit terms that even the beginner can understand with no difficulty.

Gerrard then tackles the dreaded machine code in half the time that he took over explaining BASIC. This is not such a handicap as it might seem with learning another language, since Gerrard has explained machine code in a simple, brief way. He defines all the terms that need to be known and then gives an example of how each works.

Once the basics of machine code have been explored, Gerrard sets about putting them to use in highly complex situations such as creating new words or writing interrupts. In the final part of the machine code section some useful machine code programs are included. Such as: **Hard copy** dumps the screen out to the printer; **Defining function keys** which does as its name implies and allows the user to define his function keys to do anything; and **Old** which reclaims a program which was accidentally lost when **NEW** was entered.

Then follows a detailed look at the remarkable colour, graphics and sound features of the 64. The first chapter on colour is only five pages long. This is because he only covers how to change the colour of the cursor and place characters on the screen, changing their colour by using the POKE statement.

In the next chapter, Gerrard sets about explaining high resolution graphics and 'sprites'. In this chapter he includes a game called 'Trap' which you type in and play. The program demonstrates elementary use of the graphics capabilities of the 64 in an amusing and entertaining way.

There is a quick explanation of each graphics mode and how each works. He goes into a detailed explanation of the redefinable graphics characters which is the basis of all graphics systems, and also explains multi-coloured characters and extended background mode which all leads on to high resolution graphics.

High resolution graphics is dealt with in much the same way as he does with user-defined characters. All the relevant locations that are needed are there in an easy to understand fashion.

Sprites are the next topic in the chapter. Included is a listing of a sprite generator, so if you cannot understand the concept of sprites then you can use the sprite generator to create them. There is also another listing of a game in the chapter which you can type in and play. Gerrard covers sprite collision, colour, expansion, multicouleur and many other sprite features.

Chapter six is about the '64 sound. As he says, the '64 has a remarkably gifted sound capability, aided by the 'sound interface device' (SID) chip. This is explained extremely well in this book. The SID chip is examined in great detail later on in the book along with all the other chips.

In this chapter a more practical use is explored. Subjects covered include explanations on attack, decay, sustain and release (ADSR), using multiple voices, calculating musical notes (a table is included to make this job easier), different waveforms, enveloping, filtering and a few songs to play. All together, this chapter is an excellent guide to learn how to use the '64 sound.

There is a short but highly detailed chapter on peripherals including basic saving and loading to and from disk to direct access on disk. Printers and tape decks are also given a run. Program listings are also found in the chapter, mainly for the disk drive.

Gerrard then comes to the main core of the book and his masterpiece, a detailed look at the '64 chips. He firstly deals with the well known Video Interface Chip (VIC). Many memory maps are supplied. The next chip Gerrard deals with is the SID chip. Included are pin configurations, block diagrams and control register maps.

Finally, Gerrard deals with the central processing unit (CPU) and the input/output chips. This chapter is covered in great detail and is so easy to read you do not have to be a technical genius to understand it.

The appendices are many and detailed. Every thing that is covered in the book is in one of the appendices in brief.

Overall, I found this book to be very easy to read and very comprehensive. Every one who reads it, whether they be beginners or veterans, would gain some more knowledge about the Commodore 64.

Gerrard has certainly produced an excellent book which is truly entertaining and informing. It could easily be the '64 user's bible.

Mark Lingane, Perth WA

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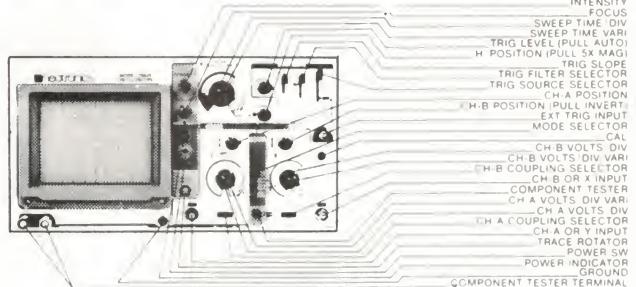
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The Neotronics OS620 is a precision measuring instrument. The tube is 150mm flat screen/internal graticule type with 2kV acceleration potential. The bandwidth is a full 20MHz on both channels. Others offer round faced tubes, plastic graticules, less bandwidth, yet cost more! Intensity modulation is built in.

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The component tester allows you to make full use of the OS620. With no additional test gear, you can check resistors, capacitors and zener diodes as well as trouble shoot solid state circuits. Testing signals are available via the COMP. TEST terminals.



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Probes included

Most users will need a set of probes. These are sold as very expensive 'extras' with some other brands - often costing over \$60.00 a pair (we think this is a bit like selling a car and then saying it's extra for the tyres!). The Neotronics OS620 comes complete with a pair of high quality probes.

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- Vertical sensitivity: 5 mV/div to 20V/div. 12 ranges
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West German 50 MHz CRO



The West German company, Norma Messtechnik, has released its model S1004 50 MHz oscilloscope through Paton Electronics. This high sensitivity, rapid timebase instrument is suitable for applications in the laboratory, in production and quality control, as well as for servicing and education in all branches of electronics, the company claims.

The S1004 has several unusual display facilities and trigger types. It displays wave forms of considerable complexity at high brightness and excellent beam focus, they say.

The S1004 is simple and fast to operate. Automatic timebase and trigger facilities put a steady image of optimum timespread on the 80x100 mm screen, Messtechnik say.

The image tube works at an acceleration voltage of 11 kV and produces a particularly bright and sharply focused beam on screen, the company says. The automatic focusing system keeps the beam well focused even if the image brightness changes. The measuring raster is attached to the inside and may be lit; it makes for parallax-free readings.

A newly developed automatic time-range circuit will always display 1.5-5 cycles of the signal applied, irrespective of its frequency. The automatically selected or manually set deflection co-efficient is shown on an LED display in milliseconds,

microseconds or nanoseconds.

The TV trigger permits triggering to the first or the second frame or to the line frequency. More detailed examination of the TV signal is possible with the help of the delay function.

For more information contact Paton Electronics, 90 Victoria Street, Ashfield NSW 2131. (02)797-9222.

Air powered screwdrivers

The APD series screwdrivers from Ellistronics are designed to handle a broad range of fastening and unfastening applications from delicate instrument assembly to electronic chassis and cabinets. These precision tools are built with a gear type driving mechanism that generates exceptional power from within an extremely compact, lightweight housing.

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Data test units

Principal units in the range of Halcyon data test instruments are the 801A Data Monitor, 802A Data Link Monitor, and 803B Data Link Analyzer. All three feature Halycon's exclusive Automonitor which automatically detects the speed, protocol, bits-per-character, and parity of the line under test. The 801A also has a powerful trapping capability that can be user programmed for selective monitoring and troubleshooting.

The 802A is a progression of the 801A, featuring increased capabilities for gathering network statistics, including an integral mass storage tape for data and programs, and larger CRT display.

The top of the range is 803B Data Link Analyzer, which has complete emulation and moni-

tor capabilities, with convenient programming provided by a full ASCII keyboard.

Also included in the Halcyon range are statistical multiplexers and the H4896 Synchronous Modem. The multiplexers are capable of concentrating up to 60 channels over a single phone link, and providing complete network reconfigurations and system-level diagnostics from a single, central location.

The modem likewise provides high performance over a wide range of conditions on both domestic and overseas transmission lines, and is designed for full-duplex point to point applications.

For more information contact Magna Techtronics, 14 Whiting Road, Artarmon NSW 2026. (02)438-3377.

New car alarm

A Talking Auto Alarm is the latest product from Powersonic Australia.

It's a keyless system that, when activated, not only emits an eardrum popping siren (120 decibels), but also a synthesised voice that cries "burglar burglar" in a frenzied tone.

If the 120 dB siren does not frighten the intending car hijacker, the voice will certainly scare the pants off him. No thief could successfully carry out his work with "burglar burglar" screaming in his ear.

Powersonic Australia has joined operations with Bestek

International of California to market this new 'Talking Auto Alarm' on the Australian market.

It is marketed through leading auto electricians, spare parts shops, electronic shops and selected petrol stations, who all have a unit for demonstration purposes and stock to service all customers.

The unit retails for \$199.

For further information you can contact Mr John Q. Nia, Powersonic Australia, Shop 43, 61-89 Buckingham St, Surry Hills NSW 2010. (02)699-2722.



APD series air powered screwdrivers.

bit upon contact with the screw, instant reverse, torque control and extremely low noise level which enhances their use in a laboratory or cleanroom environment.

A complete inventory of bits and spare parts is available. Tools and accessories are available from Ellistronics Pty. Ltd., 797 Springvale Road, Mulgrave Vic 3071. (03)329-7500.



PC board work centre

A new combination of Scope Panavise components produces a pc board work station with many features designed for professional service technicians. Pc boards up to 300 mm wide can be held vertically, horizontally or at any intermediate angle, by two retaining arms. They both slide independently. One is spring loaded for fast board changes.

The 180° swivel and lock base

lets the operator adopt any board position. The base with non-skid pads accommodates small parts, a tip wiping sponge and safety iron stand for any iron up to 15 mm 0 plus a solder reel dispenser.

All parts are rigidly connected to allow one handed portability. Recommended trade price is \$123 plus tax.

For further information contact Ian Pittman, Scope Laboratories. (03)338-1566.

New 300 baud modem

Centre Industries, a division of the Spastic Centre of NSW, has announced the addition of a new 300 baud data modem to the Cicada 300 series.

To be marketed as the Cicada 300C or 300CT (with integral telephone), the new modem provides inter-computer communications over the switched telephone network or private lines and is specifically designed for use with the Commodore 64 and IC 20 computers.

Both models offer substantial

savings since neither requires the use of an interface adapter or power pack. Additionally, the modem can easily be installed by the end-user. Designed to conform in all respects to the recommendations of CCITT-V21, the two modems hold Telecom approval no. C83/37/1113.

More information can be obtained from Centre Industries, 187 Allambie Road, Allambie Heights NSW 2100. (02) 451-5555.



Six-trace oscilloscopes

Two new models in the TRIO range of oscilloscopes feature three channels which can be displayed simultaneously using the main sweep while individual delayed waveforms of these

channels can also be displayed, providing a total of six traces. The CS-1060 has a bandwidth of 60 MHz and the CS-1040 has a bandwidth of 40 MHz.

Other features include sensi-

tivity down to 1 mV/div, a 150 mm rectangular, high resolution 16 kV CRT and eight divisions of dynamic range for accurate, undistorted waveform display. They also have vertical-axis signal output (for a frequency counter, etc), automatic synchronizing of video signals and a trace rotation control for compensating for the earth's magnetic field.

Parameters has also released the new TRIO CS-1022 with dual traces and operating up to 20 MHz.

The front panel layout was redesigned for the CS-1022 sweep multiplier allows a user to magnify the sweep at the touch of a button to view parts of complex waveforms. The accuracy of this scope is guaranteed to +3% over a temperature range of 0°C to 40°C.

For further information contact Parameters Pty Ltd, P.O. Box 573, Artarmon NSW 2064. (02)439-3288.



Intelligent DMM

Perth based Radio Spares has become distributors for the Thurlby 1905a programmable 5½-digit DMM.

Radio Spares claim exceptional resolution for its new product. It can measure 1 mV in 200 V. Input impedance is 10M on the voltage ranges, except for the lower two, where it rises to 1000M.

The 1905a has a programmable filter that can be used to filter unwanted noise from the input.

Voltage can be expressed in dBv, dBm or dBr, given an appropriate reference point. Output can be scaled, averaged or offset, and maxima or minima stored for later retrieval.

For further information contact Radio Spares Components, 28-30 Northwood St, W. Leederville WA 6007. (09)381-4799.

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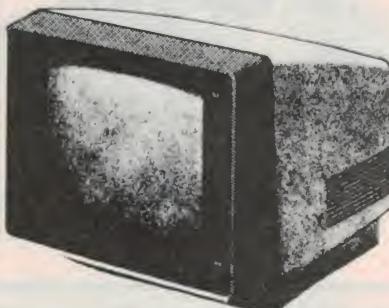
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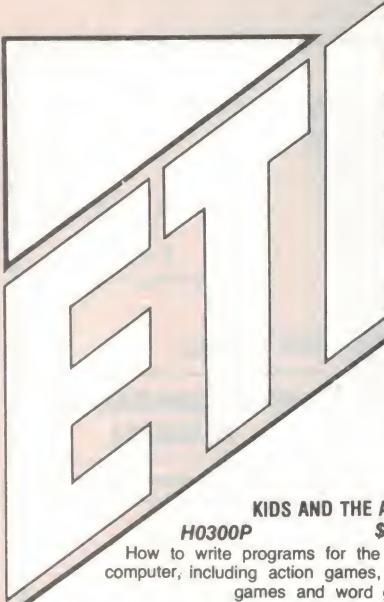


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It is a solid text for introductory programming courses in Cobol, using a format that is easy to understand, yet comprehensive enough to make supplementary readings unnecessary.

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Presents a complete introduction and tutorial on programming in BASIC using Microsoft BASIC, Release 5.0. Covers branching and loops, strings, editing, arrays and files, and arithmetic in BASIC.

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This guide to software teaches you about machine language, assembly language programming and BASIC. The emphasis is not on learning to write programs but on learning to use the thousands of available programs that have already been written.



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H0153A **\$19.95**

A guide to computer and peripheral preservation. Specific advice for the computer, floppy disks, hard disks, the CRT terminal, the printer, tape units, the computer room, software and documentation.

USING THE IBM PERSONAL COMPUTER

J0319P **\$21.50**

This all-purpose beginner's book is a complete guide to the IBM-PC

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K0227A

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Principles of assembly-language programming for the 6502 microprocessor are taught in this introductory text. Includes a discussion of trade-offs between hardware and software and detailed explanations of the 6502's internal registers and bus operation. Third edition.

THE ART OF PROGRAMMING THE 1K ZX81

K0226B

\$6.75

This book explains how to use the features of the ZX81 including its random number generator, graphics and timer. PEEK and POKE are explained and you should learn enough to develop programs of your own.

HOW TO WRITE AN IBM-PC PROGRAM

K0184P

\$23.25

Virtually identical to *How to Write an Apple/TRS-80 Program*. Changes have been made to allow for differences in the two machines and variations in BASIC.

APPLE FILES

K0190P

\$21.95

This book is for people who know some BASIC and would like to expand and apply this knowledge by using the capabilities of the Apple. Includes programs for the stock market, inventories, grades and medical records.

PASCAL PROGRAMS FOR SCIENTISTS AND ENGINEERS

K0181A

\$23.50

More than 60 of the most frequently used scientific algorithms, with program implementation in Pascal.

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Includes C programs that each explore a particular aspect of C, detailed descriptions of how the programs work and tips on writing successful C programs.

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COMPUTER PROGRAMS IN BASIC

K0192P

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Fully indexed guide to more than 1600 BASIC computer programs published in personal computer magazines for microcomputers, minicomputers and mainframe computers. Compiled by Paul Friedmann, first published in 1981.

EXPERIMENTS IN ARTIFICIAL INTELLIGENCE FOR SMALL COMPUTERS

J0168P

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Artificial intelligence is the capability of a device to perform functions normally associated with human intelligence. With this book, a small computer with extended BASIC and some knowledge of BASIC language, you can conduct experiments in artificial intelligence.

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Covers all essential areas including number systems, codes, constructional and sequential logic, analogue/digital/analogue conversion.

LONG-DISTANCE TELEVISION RECEPTION (TV-DX)**N0250B** \$6.95

Written by the British authority, the book includes many units and devices made by active enthusiasts. A practical and authoritative introduction to this unusual aspect of electronics.

SOLID-STATE SHORTWAVE RECEIVERS FOR BEGINNERS**C0044B** \$5.95

Design and construction of several solid-state shortwave receivers giving high level of performance yet utilising few components.

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It contains virtually all the information you need to design and build electronic circuits, systems and subsystems with readily available ICs. Shows how to interface them into highly complex systems.

**MICROPROCESSOR INTERFACING TECHNIQUES****J0167A** \$29.95

Teaches you how to interconnect a complete microprocessor system and interface it to the usual peripherals. The hardware and software skills needed to effectively interface peripheral devices are covered along with various bus standards and A/D conversion. Third edition.

SOUND-SYSTEM ENGINEERING**G0129P** \$35.50

Dealing with audio systems as a whole, it includes installing and equalising the sound system and interfacing the electrical and acoustic systems, instrumentation, the acoustic environment and designing for acoustic gain.

PRACTICAL ELECTRONIC CALCULATIONS AND FORMULAE**B0027B** \$9.95

For the practical person's workbench. Bridges the gap between technical theory and cut-and-dried methods which work but leave the experimenter unfulfilled. There's a strong practical bias. High maths avoided where possible.

RADIO CONTROL FOR BEGINNERS**C0034B** \$5.95

How complete systems work with constructional details of solid-state transmitters and receivers. Also included — antennas, field strength meter, crystal controlled superhet, electro-mechanical controls. Section dealing with licensing, etc, is not applicable to Australia.

ELECTRONIC CALCULATOR USER'S HANDBOOK**M0245B** \$5.50

Presents formulae, data, methods of calculation, conversion factors, etc, for use with the simplest or most sophisticated calculators. Includes the way to calculate using only a simple four-function calculator, trigonometric function, hyperbolic functions, logarithms, square roots and powers.

HANDBOOK OF ICs EQUIVALENTS AND SUBSTITUTES**B0281B** \$6.95

Contains full interchangeability data on more than 9500 ICs with possible alternatives and equivalents shown. Covers many types of digital and linear ICs. Recently reprinted.

ELECTRONIC TROUBLESHOOTING HANDBOOK**F0257P** \$11.50

This workbench guide shows you how to pinpoint transistor troubles in minutes, how to test almost everything electronic and how to get the most out of low-cost test equipment.

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE**B0018B** \$9.95

Contains a huge amount of information on modern transistors produced by more than 100 manufacturers. Wherever possible, equivalents are subdivided into European, American and Japanese types.

...Plus great buys on ETI Bestsellers!

HOW TO MAKE WALKIE-TALKIES**D0056B** \$6.95

This treatise on low-power transmitter-receivers (walkie-talkies) covers many aspects, from licensing requirements and bands, through practical circuitry and construction to the types of aerials that may be used.

ELECTRONICS SECURITY DEVICES**D0059B** \$6.95

Besides including both simple and more sophisticated burglar alarm circuits using light, infra-red and ultra-sonics, this book also gives circuits for gas and smoke detectors, flood alarms, fire alarms, doorphones, etc.

HOW TO BUILD SPEAKER ENCLOSURES**G0131P** \$9.50

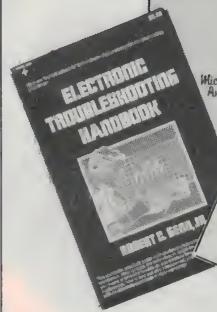
A guide to the 'whys' and 'hows' of constructing top-performance loudspeaker enclosures.

MODEL RAILWAY PROJECTS**D0054B** \$6.75

Projects include such things as controllers, signals and sound-effects units. Construction stripboard layouts provided for projects.

WALL CHART — HOW**TO IDENTIFY UNMARKED ICs****B0019B** \$2.95

This chart shows the reader how, with just a testmeter, to go about recording the particular 'signature' of an unmarked IC which should enable the IC to be identified with reference to manufacturers or other data.

BASIC for accountants**THE CP/M HANDBOOK (WITH MP/M)****K0173A** \$24.95

Contains a step-by-step description of all the CP/M command features. Designed for the beginner, the book progresses to detailed explanations of the file transfer, debugging and CP/M text-editing programs.

PROGRAMMING THE Z80**K0231A** \$26.95

This book will enable every reader to write complete application programs for Z80-based computer systems. Includes exercises to measure progress and comprehension at each level of programming.

THE C PROGRAMMING LANGUAGE**K0272P** \$26.95

C is a general purpose 'low-level' programming language. It is not specialised to any particular area of application, but its absence of restrictions make it convenient and effective for many tasks.

BASIC FOR ACCOUNTANTS**L0234P** \$11.95

Shows accountancy students and accountants how to use a computer to perform the repetitive tasks associated with record keeping, calculating and report writing. Using the BASIC language attention is concentrated on debtors, inventory and general ledger systems.

BEGINNING BASIC**H0146A** \$24.95

Intended for beginners with no computing experience, one should be able to intelligently program in BASIC in a short time.

INTERFACE PROJECTS FOR THE APPLE II**J0158P** \$17.95

A series of interface projects that are easily built and enable the user to realise the computer's potential through project construction. Projects are primarily hardware-orientated, with some software supporting the hardware.

STARTING FORTH**K0177P** \$25.00

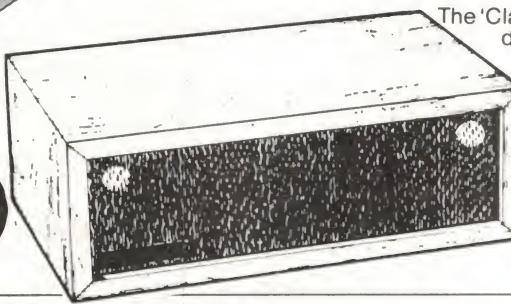
A clear and complete guide to Forth, this book covers fundamental principles and then a full set of high-level Forth commands. It concludes with advanced techniques and style.

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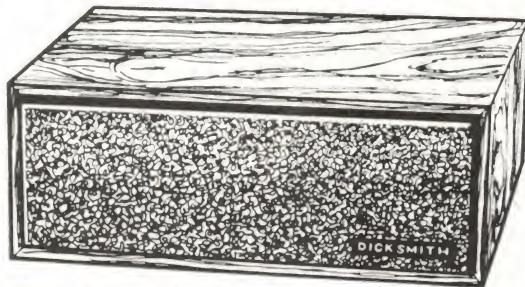
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ULTRA- SONIC BLASTER!

The 'Claytons' alarm: the ideal alarm for those who don't want to put in alarms! This one is fully self contained, including siren speaker. Just place it on the shelf and its invisible ultrasonic rays detect movement. Fantastic for single room protection; can also be used as a sensor on a master alarm console. Includes sensitivity control, operates from external 12V battery, from mains via optional plug-pack with internal battery back-up. Has provision for external speaker, sensors, etc. Cat L-5108

Bookshelf Control Module

Easy to install



A great alarm system for the home, flat, etc -- because it doesn't look like an alarm! So anyone entering your property could easily be fooled into thinking this was a small speaker - until they were caught! This module has another big advantage too - it's fully self contained. While there is provision for external horn speaker, it has its own speaker built in, hidden behind the 'speaker grille' front panel.

AC/DC operation: optional AC adaptor can be fitted to use mains: unit automatically switches back to battery if mains is interrupted. Built-in test LED for checking that the system is working before you leave.

Cat L-5102

**LOW
COST
PROTECTION** **\$59⁵⁰**

INNOCENT VICTIMS OF BURGLARIES 'VIOLATED'

VICTIMS of burglaries feel violated when their home has been ransacked, according to a psychologist.

By PAM LESMOND

"They feel as though their home is no longer their castle - it's extremely upsetting, especially if things have been overturned or messed up," Dr Lyn Barrow said.

Dr Barrow said if the victim suffers another burglary they can become extremely nervous and frightened.

Dr Barrow said burglary victims suffer from enormous stress after repeated attacks. "People living alone, especially elderly women, are prone to severe stress."

He said some people become too scared to leave their homes because they fear it will be ransacked.

"I think we should be looking at the reasons why people steal rather than imposing harsh sentences," Dr Barrow said.

Another psychologist, Dr Robert Spillane, said people rarely believe they will fall victim to a burglary attack.

'The Sun'
9th May,
1984

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Cat C-2705

WARNING STICKER



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Cat L-5310

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Mounted so the magnet holds the switch closed, if the door is opened, switch opens. Attaches to most alarm systems.
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Barrel type key switch with two keys, used at entry-exit point for turning the alarm system on-off.



\$7.25

HEAT/FIRE SENSOR

Most alarms have provision for a fire sensor. Take advantage of it and protect your home and property! Use any number of sensors in likely 'hot spots'.
Cat L-5254



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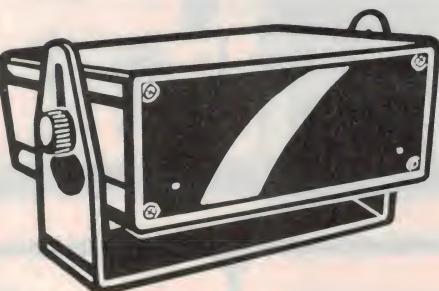
Pressure Mat

An ultra thin mat for placing under carpets, in walkways, etc. N.O. in the standby state, goes closed circuit when walked on.
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A779/JL

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Want to catch them in the act? Silent, invisible microwaves detect any movement in the target area and trigger the alarm device. 12V operated. Range up to 15 metres, attaches to any alarm system!
Cat L-5000

**Silent Invisible
Movement Detector**

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FREE!

Your home is on the 'hit' list — your valuable property may be the gleam in a crook's eye tomorrow! You need help!! Here it is: our specially written guide to installing a professional alarm system. That's right every home now needs protection — and we'll show you how to install an alarm that will deter even the persistent pest. The guide is FREE with any purchase of \$1.00 or more for July only! Ask for your copy when you're in a Dick Smith Electronics store or with your next mail order.



100% Hidden Magnetic (Reed) Door & Window Switches

What a great idea! Ideal for all alarm systems — usable in wood, aluminium & other doors/windows. Just drill a 10mm hole for switch in jamb and the magnet in door or window. They push in and are covered by window/door when closed — no one knows they're there! Operates between 8 & 10mm.

Set of reed switch & magnet plus four mounting screws.
Cat L-5212

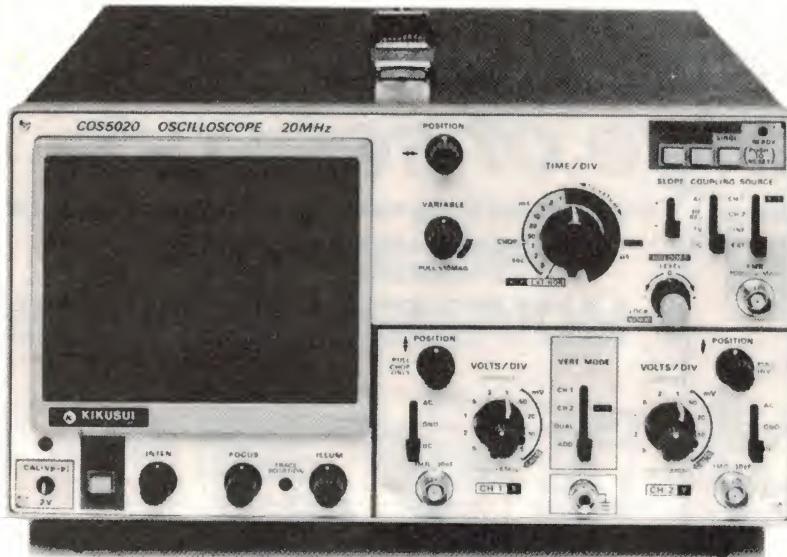
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See page 152 for full address details



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PROBES**

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- 5mV/div sensitivity
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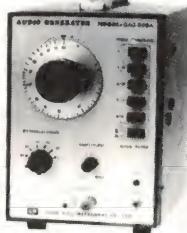
Generates sine, triangle, square, pulse and ramp waves

- 0.2 to 2MHz
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GAG-808A AUDIO GENERATOR

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Covers 10Hz to 1MHz



- 20Vp-p open circuit output
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GPS-3030 POWER SUPPLY

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Provides 30V at 3A

- Short circuit protected
- Auto constant voltage, constant current indication
- High line and load regulation

GPS-3060 POWER SUPPLY

\$334.00

Provides 30V at 6A

- Similar to GPS3030



DCM-100 CAPACITANCE METER

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Measures capacitance from 200pF to 2000 uF

- 3½ digit LCD display
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- Internal calibration adjustment
- Protection against charged capacitors



AT301 LOGIC PROBE

Checks TTL and CMOS circuits

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- 10MHz max input
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Simplifies checking of ICs

- Suits 16pin DIP spacing
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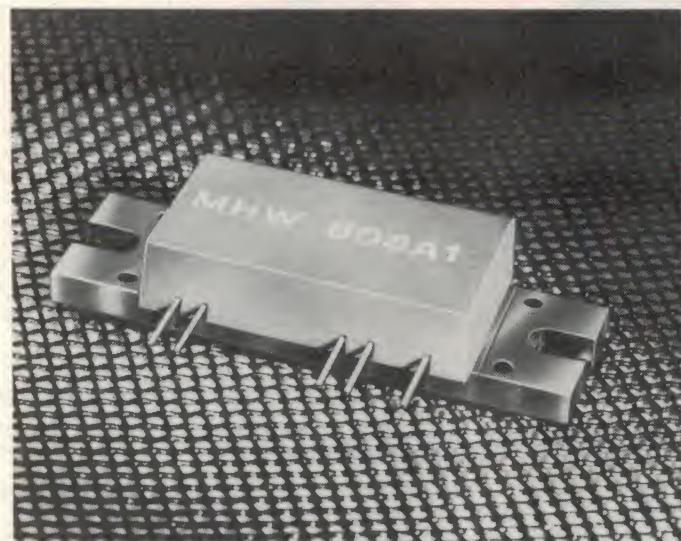
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specialising in electronic components for the professional and hobbyist.



New hybrid amplifier module

A new series of three-stage common emitter hybrid amplifier modules, designed for 800 MHz cellular mobile radio applications, has been introduced by Motorola.

The three elements in the series are called the MHW808A1, MHW808A2 and MHW808A3. They have a typical power output of 7.5 watts and a typical power gain up to 25 dB. Its class A input stage allows automatic gain control over 35 dB in output power range.

The amplifiers are constructed with thin-film interconnections and gold-bonded silicon-nitride-

passivated transistors to provide for small size and high reliability.

The series employs three common emitter stages cascaded to provide over 35 dB of gain. The devices are specified at 12.5 volt, UHF characteristics.

For more information contact **Motorola, 250 Pacific Highway, Crows Nest NSW 2065. (02)438-1955.**

High performance micro

The first prototype samples of the new super microprocessor, the 80286, have arrived in Australia.

Especially suited to multi-user, multi-tasking systems, the SAB 80286 incorporates memory protection that supports operating systems and task isolation, as well as program and data privacy within tasks. The 8 MHz version has the capability to handle a throughput of up to six times that of a standard, 8086. The SAB 80286 features a memory management system that will map one Gigabyte of virtual address space per task into 16M of physical memory.

SAB 80286 is upward compatible with 8086 and 8088 software. Other design features of 80286 include two 8086 upward compatible operating modes; 8086 Real Address mode and Protected Virtual Address mode.

A range of clock rates will be available, although the higher speed versions (8 MHz) should be more popular, due to reduced cycle times aiding higher throughputs.

For more information contact **Promark Electronics, 366 Whitehorse Road, Nunawading Vic 3131 (03)878-1255.**

Australian solid state relays

Solid state relays designed and developed in Australia are now available from Promark Electronics. Initially available in an industry standard compact, vertical package, the first models are designed as 2 A and 5 A 240 V devices. They use the latest opto-coupled, zero voltage crossing device to trigger a triac. A current limiting device (with reverse protection) allows input voltages of 3-15 volts without external resistors.

A unique feature of these devices is the availability of an

optional snubber and/or metal oxide varistor, to limit inductive loads. This enables large users of solid state relays to have devices tailored to suit their individual requirements. This custom facility will be expanded to include higher current devices as required, with the next production model likely to be rated at 24 A.

Further information and design details are available by contacting **Promark Electronics, 366 Whitehorse Road, Nunawading Vic 31341. (03)878-1255.**

Marconi to second source Intel chip

Intel Corporation, one of the world's leading microcircuit designers and volume manufacturers, has entered into an agreement with the GEC Group to allow Marconi Electronic Devices of Lincoln, eastern England to second source one of its integrated circuits.

This is the first time Intel have signed such an agreement with any UK company. The agreement sets out that Intel and Marconi will dual source a telecommunications integrated circuit in CHMOS. The circuit, a combination Codec and Filter (Combo) is used in large quantities in most telecommunications systems now being developed or manufactured throughout the world.

Samples of the integrated circuit are expected to be made available from Marconi during the first half of 1985.

The availability of Combo circuits over the next 3-5 years may well be a major factor in many of the UK's key telecommunications programmes. Intel expect this arrangement with Marconi to be of considerable benefit to the UK telecommunications industry.

Hybrid regulators

Electromark has announced the release of the latest hybrid regulators from ILP Electronics.

The HR 314 and HR 614 provide a constant 13.8 volt dc output at three or six amps respectively. The modules are encapsulated in a heat sink and are short circuit proof. They require a dc input of between 16 and 30 volts.

For more information contact **Electromark, 43 Anderson Road, Mortdale NSW 2223. (02)570-7286.**

Drafting Aids

Associated Controls Pty Limited has recently been appointed Australian Distributor for the complete supply of printed drafting aids manufactured by Draft Material Co. Limited of Japan. This Company is Japan's largest supplier of printed circuit drafting aids and holds a 70% share of the Japanese market.

A wide selection of artwork tapes, die-cut symbols, templates and other materials are available to assist the PCB draughtsman.

Further information can be obtained from **Associated Controls Pty Ltd. (03)561-2966.**

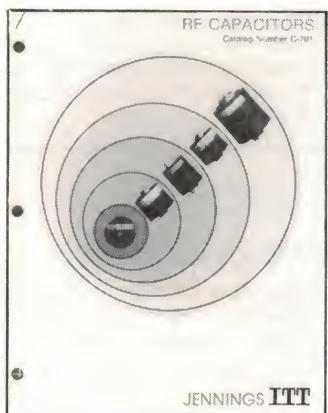
RF capacitors

ITT Jennings has released the latest technical data on their range of RF capacitors.

They are marketing Titanate capacitors for use in high kVA rating applications.

The company also offers complete environmental and RF testing of its products to any desired specification.

The capacitors and technical data on them are available from **STC Cannon Components, 248 Wickham Rd, Morabbin Vic. 3189. (03)555-9566.**



The right connections

When you're dealing with low level signals in professional audio applications, such as in public address stage sound systems, the right connector makes all the difference between a smooth running, reliable system and the frustrations of intermittent sound loss.

Ultra thin toroidal transformer



The new low profile transformer from ILP.

Booster

Electromark has announced the release of two booster amplifiers for mono and stereo output boosting. They are coded C15 and C1515 respectively. They are both designed to take the signal from an existing output, and boost it to 15 W rms. The 3 dB points are claimed to be at 15 Hz and 30 KHz. For more information contact **Electromark, 43 Anderson Street, Mortdale 2223. (02)570-7286.**

High contrast LCD

Anew, high contrast liquid crystal display range has been released onto the Australian market. Although available overseas, this type of display has been previously unavailable in Australia.

In addition to the increase in contrast, these displays feature special seals to resist high humidity levels. They are suitable for a wide range of operating temperatures, both above and below previous limits.

Dichroic displays are available, offering designers a wide range of colours. A variety of

Electromark has just released a new slimline transformer, the X92878.

At the request of Mr Bob Barton — design engineer at Sydney's Channel 7, ILP Transformers produced the new transformer to fit in a single unit 19" rack. The transformer has a rating of 160 VA ± 30 V. Diameter is 155 mm and thickness of less than 35 mm. Mounting is by 20 mm M8 central insert.

More details from **Electromark, 43 Anderson Road, Mortdale 2223. (02)570-7287.**

reflectors or transfectors are also available.

The displays are available in both static-driven and multiplexed form, featuring many wanted symbols such as "Lo Batt" and over-range indicators. Custom designs are readily achievable, with three weeks turn-round-time offered on custom displays. A comprehensive range of compatible driver ICs is also readily available.

For more information contact **Promark Electronics, 366 Whitehorse Road, Nunawading Vic 3131. (03)878-1255.**

Shield your zipper

Zippertubing' provides a simple solution to problems caused by birds nests of wires and cables that sometimes seems to create themselves despite the best intentions of designers.

It consists of a flame, dirt and temperature resistant jacketing that can be zipped up around recalcitrant cables. A new, shielded, version of this product is now available.

Marketed in Australia by Adimex Trading, shielded Zippertubing is an effective way to solve problems caused by EMI and RFI. There is provision to ground the shielding as determined by the system design.

According to the manufacturer, shielded zippertubing conforms to the American FCC, European VDE and MIL specifications.

For more information, contact **Adimex Trading, P.O. Box 219, Ringwood, Victoria.**



A-D converter



Datell's new ADC-7109 is a low cost, high performance, low power integrating A/D converter designed to interface with a wide variety of microprocessors.

Completely self-contained, the ADC-7109 includes a buffer amplifier, integrator, comparator, 12-bit binary counter and three-state outputs which enable the device to be interfaced to virtually any 8 or 16-bit microprocessor data bus.

In the byte-organised parallel mode, the ADC-7109 can interface with the data busses of microprocessors such as the

Motorola MC6800 and the Intel 8080 and 8048. In this mode, 14 data outputs provide 12 magnitude bits, polarity and overrange.

The outputs can be grouped in two 8-bit bytes, each activated by its own byte-enable signal and a master chip-enable line. A UART handshake mode is also provided to allow operation with industry-standard UART's in the serial data transmission mode.

For more information contact Elmeasco Instruments, P.O. Box 30, Concord NSW 2137. (02)736-2888.

Multiple colour LCDs

Seiko Instruments began selling its multiple colour LCDs on May 1 in Japan. The eight colour displays have 64 x 160 picture elements that can be black, white, green, blue, purple, cyan, red and yellow. The displays come in modules that measure 170 mm x 100 mm and 200 mm deep.

Seiko uses a special macro-molecule electrodeposition technology to construct the displays.

The makers are hoping to use the modules as replacements for video displays in personal computers. They are planning a four colour version of the module with 640 x 200 pixels to be ready by the end of the year.

Teledyne semiconductor manual

Promark Electronics, Australian distributors of Teledyne Semiconductor products, has the new 1984 Teledyne Data Acquisition Products Design Handbook.

The last manual from Teledyne Semiconductor was in 1981. Emphasis in the new book is on data acquisition and related products, including Teledyne's range of high quality A/D converters based on the industry standard 7106/7126/

7135 series.

As well as extensive data on the individual products, specific sections also cover cross referencing, packaging, handling precautions and quality assurance. A large section of the book covers applications of the devices.

To obtain this handbook contact Promark Electronics, 366 Whitehorse Rd, Nunawading Vic. 3131. (03)878-1255.

What is better than NiCad for memory back-up?

NEC



SUPERCAP of course!

Unlike NiCad —

- It never needs replacing or maintenance.
- It does not exhibit discharge memory.
- It can be wired either way. Lack of polarity enables this.
- It can be soldered onto P.C.B.s with other components.
- It can be charged at high and low current rates, i.e. microamps to amps.
- It is completely safe. It will not explode under extremes of temperature, nor will it leak.
- It is small and compact.

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FZOH223Z	0.022	5	5.5	50
FZOH473Z	0.047	5	5.5	40
FZOH104Z	0.1	5	5.5	45
FZOH224Z	0.22	5	5.5	25
FZOH474Z	0.47	5	5.5	13
FZOH105Z	1.0	5	5.5	7

* Equivalent series resistance

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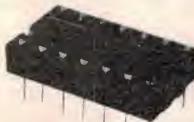
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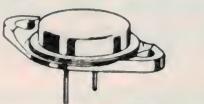


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Z1512 2SJ 49

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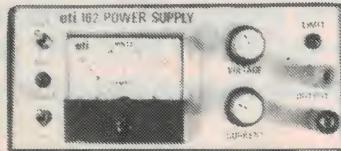
Z1174 \$1 EA

LEDS

Z 0140	Led 3mm Red	.14	.10
Z 0141	Led 3mm Green	.20	.18
Z 0143	Led 3mm Yellow	.22	.20
Z 0150	Led 5mm Red	.14	.10
Z 0151	Led 5mm Green	.20	.18
Z 0152	Led 5mm Yellow	.22	.20
Z 0154	Led 5mm Orange	.25	.22
Z 0159	Led 5mm Flashing F RL4403	.49	.45
Z 0160	Led Rectangular Red	.22	.19
Z 0162	Led Rectangular Green	.25	.22
Z 0164	Led Rectangular Yellow	.25	.22
Z 1072	Led Infra Red CQY89A	.55	.52

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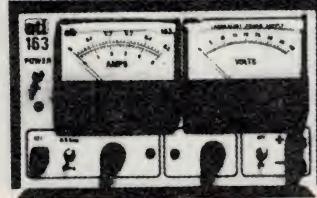
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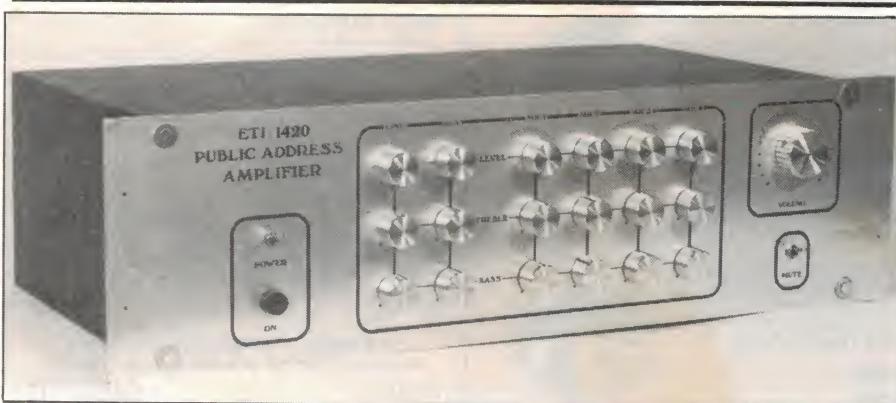
K3325 (PICTURED) \$175.00



FEATURING: VARIABLE CURRENT LIMIT-DUAL METERING

Modular paging amplifier/sound system

This project utilizes the preamp described in May and the ETI-499 150 W MOSFET power amplifier to implement a cost effective and sophisticated paging system for clubs and large halls.



THE DESIGN philosophy of the ETI-1420 has centred largely on not reinventing the wheel. We have used, with slight modifications, two existing projects that fulfil all the necessary requirements to build a first rate paging system. The only re-design necessary has been associated with making the two projects work together.

This project was conceived as a high quality public address amplifier offering six inputs with independent level, bass and treble controls. It should be suitable for use as a paging amplifier in a club or hotel installa-

tion or as a sound reinforcement amplifier for a small band or a church hall.

The prototype was constructed using a 5½ by 19 inch rack case which produces a very professional looking unit, although the electronics may be fitted into a cheaper case if desired. The amplifier has a balanced output which can be used to connect other slave amplifiers or to send to a mixer. It should also be possible to use the balanced output to bridge two ETI-499 MOSFET power amps to produce 300W into 8 ohms, although we haven't tried it.

SPECIFICATIONS ETI-1420 PAGING AMPLIFIER

Measured from preamp inputs to power amp input

Sensitivity

Input levels required to drive the power amp to full power output. Tone controls 'flat'.

Line input	200 mV RMS balanced
Aux. input	70 mV RMS
Mic. input	600 μ V RMS balanced

Signal/Noise Ratios

Line/Aux. inputs	-72 dB, hum and noise
Mic. Inputs open	-57 dB
560R load	-54 dB
Line output	2 V RMS (nom.) balanced

Geoff Nicholls

Six ETI-1421 preamps provide the front end of the amplifier. With slight modifications it proved possible to provide a variety of input characteristics. Four of the inputs provide a balanced input for 500 μ V signals, one provides a balanced input for 70 mV signals and the sixth one has an unbalanced input for 200 mV. All the inputs are individually controllable with separate level, bass and treble controls. There is also a master volume control to set the gain of the mixer stage.

The '1421 modules are suitable for low impedance balanced microphones only. In order to provide a balanced line input it is necessary to reduce the gain in one of the preamps to unity. This is achieved by changing R3 and R4 to 1k 1% and substituting a 22 pF ceramic capacitor for C3.

To use the '1421 as an unbalanced amplifier it is necessary to delete IC1 and its associated components (R1-R4, C2, C3, C12, C13) and connect the input signal straight across RV1. If more gain is required then R6 may be increased as required.

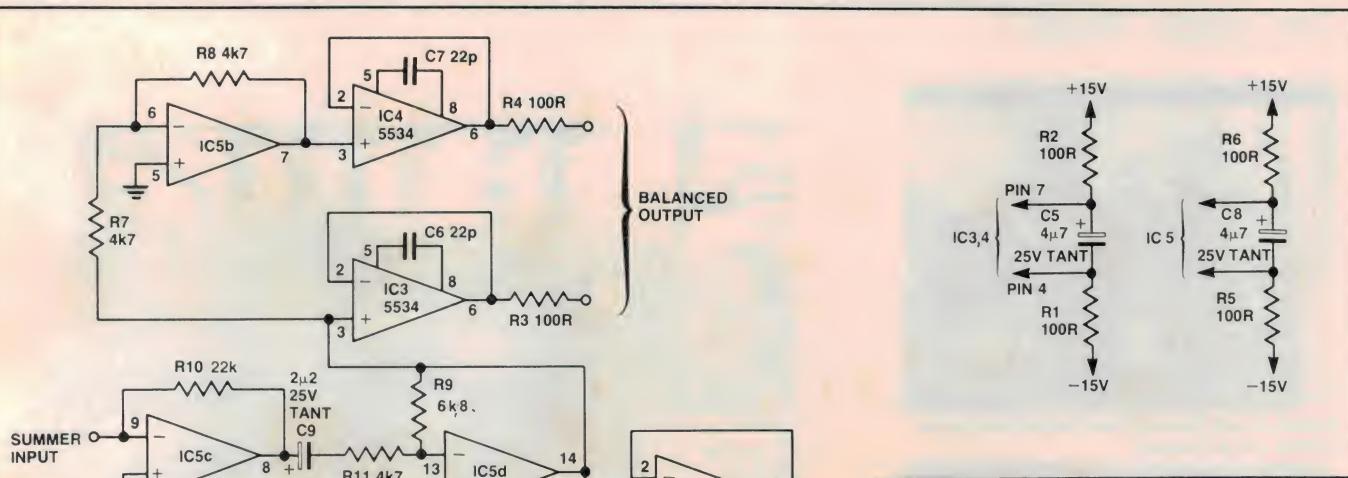
We have included a mute facility on the amplifier to allow the controller to shut down all except one channel. This would allow priority calls to override other inputs. Paging for telephone calls is a case in point.

The power amp is the ETI-499 MOSFET amp first described in March 1982. In this application it is used to drive an OP597 output transformer. This is used to step the output voltage up to 100 V. The OP597 is made for Auditek Australia of Sydney by Ferguson Transformers. Supplies should be available in most capital cities. In the event of problems, contact their Sydney offices (see Shoparound column this issue).

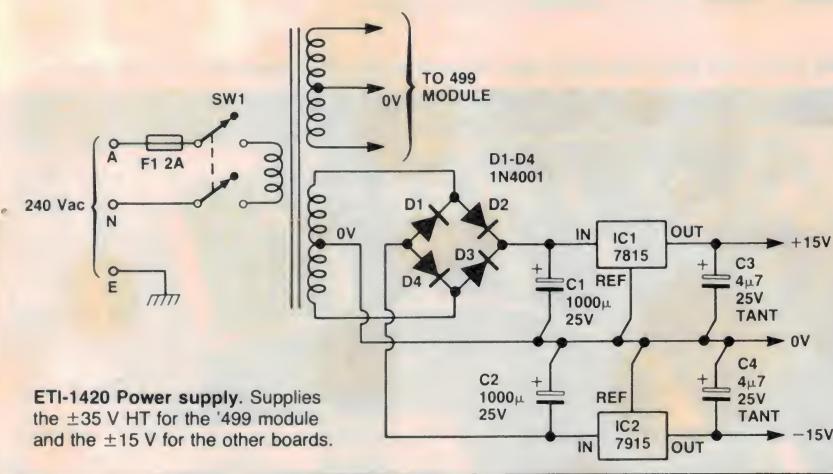
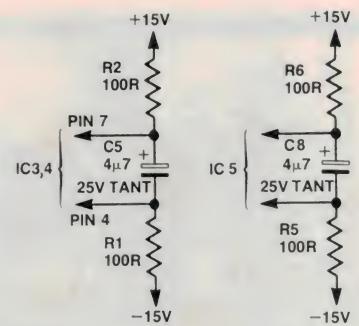
The previous P.A. amp (the ETI-498) used the OP590 which is inferior to the OP597 in that it is an autotransformer and thus does not isolate the line output from the power amp or provide a balanced output.

Construction

The most difficult aspect of the project is the metalwork, which will take several hours to mark out and fabricate. It is important to get all the dimensions correct, especially with the front panel since the input boards are mounted by the pc-mount pots so any errors are likely to make it difficult to fit them properly. The 19" rack cases are expensive, so take care! Before any holes are made I suggest you try putting all the



ETI-1420 'Summer' circuit. Outputs from the '1421 preamp modules are all connected in parallel and summed at the '1420 input.



ETI-1420 Power supply. Supplies the ± 35 V HT for the '499 module and the ± 15 V for the other boards.

HOW IT WORKS ETI-1420

The project consists of six input preamplifiers, a mixing stage with a balanced output, the MOSFET power amplifier, the 100 V line output transformer and the power supply transformer.

MICROPHONE PREAMPLIFIERS

ETI-1421 modules are used for the six preamplifiers. Four of them are wired for low impedance balanced microphones as in the ETI-1421 article in May 84, except that coupling capacitors C7, C12 and C13 are not needed, and should be replaced by links. The other two input preamps are wired to provide a balanced high level input and an unbalanced high level input.

The balanced high level input (the LINE input) has the differential amplifier gain set to unity by changing R3 and R4 in the ETI-1421 to 1k0 1% and by adding C3, a 22 pF ceramic capacitor, to compensate the 5534 for unity gain. Once again C7, C12 and C13 should be deleted.

The unbalanced high level input (the AUX input) is implemented by deleting the differential amplifier stage and connecting the input signal directly across RV1 in the ETI-1421 preamp. The gain of this input may be adjusted by varying R6. Again, C7 should be deleted.

The muting is arranged so that all inputs except MIC1 are disabled when the mute switch is operated. This is done by paralleling the mute inputs on the five boards and wiring them to the front panel switch.

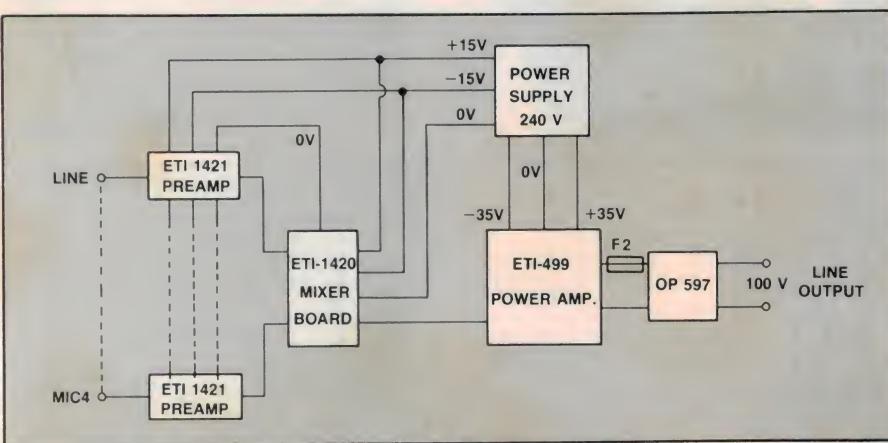
MIXER STAGE

Each of the preamplifier boards has output resistors (R14, R15) to feed the current-summing virtual-earth mixer IC5c on the ETI-1420 board. The mixer stage is ac coupled to the inverting op-amp stage IC5d which drives the master volume pot. and the balanced driver. IC5b inverts the signal for the out of phase driver IC4. The balanced output could be used in a bridging amplifier if desired.

The ETI-1420 PCB also carries the power supply components for all the preamplifiers. The standard 3-terminal regulators deliver + and -15 V from the two 15 Vac windings on the PF4361/1 transformer.

POWER AMP

The ETI-499 MOSFET power amp module was described in ETI March 1982 and is used in this project. It will deliver 150 W RMS into 4 ohms when used with the PF4361/1 transformer. The output from the '499 drives the primary of the OP597 line output transformer to step the voltage up to 100 V, and provide a balanced and isolated output.



ETI-1420 Block diagram

modules and transformers in the box to see if any clearance problems occur. Read through the rest of the construction before removing any metal and you'll avoid problems later.

The prototype was fitted into a rack that has corner bars and a light gauge cover, so it was necessary to make up brackets to mount the transformers along the sides so

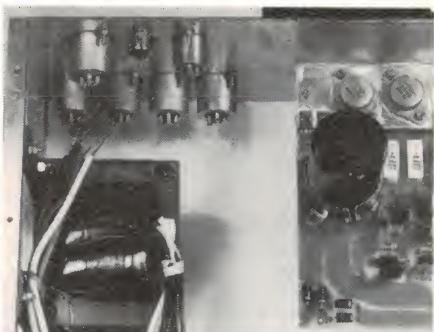
the unit is well balanced and easy to carry. Other styles of cases will require other mounting techniques, so be prepared to improvise here.

Mark out and drill the front panel. I used one of the ETI-1421 PCBs as a template while drilling the input pot shaft holes to ensure the pots would fit properly. I suggest everyone do this. Don't drill through the

Project 1420



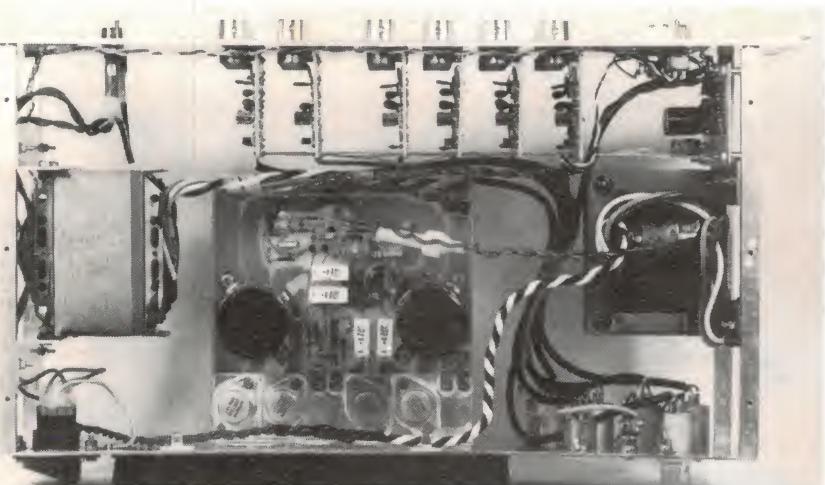
Socket wiring. Showing how the input and output sockets wiring is routed.



Output tranny mount. Two pieces of flat metal strip are used to mount the OP597 100 V line output transformer.



Power tranny mount. Two pieces of 13 mm aluminium angle are used to mount the PF4361/1.

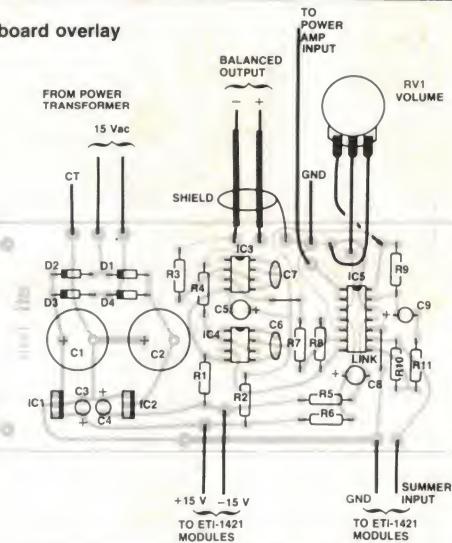


Above. Internal view of the completed project (from the bottom) showing general routing of wiring. A twisted-pair of heavy duty hookup wire is used on the '499 input; likewise the output (note line fuse). The '499 module heatsink mounts horizontally on the rear panel.

Below. View of rear panel (from top of case), showing wiring routing to sockets on the rear panel.



ETI-1420 'summer' board overlay



PARTS LIST ETI-1420

Resistors all 1/2W, 5%

R1, R2, R3, R4, 100R
R5, R6 100R
R7, R8, R11 4k7
R9 15k
R10 6K8
RV1 10k Log

Capacitors

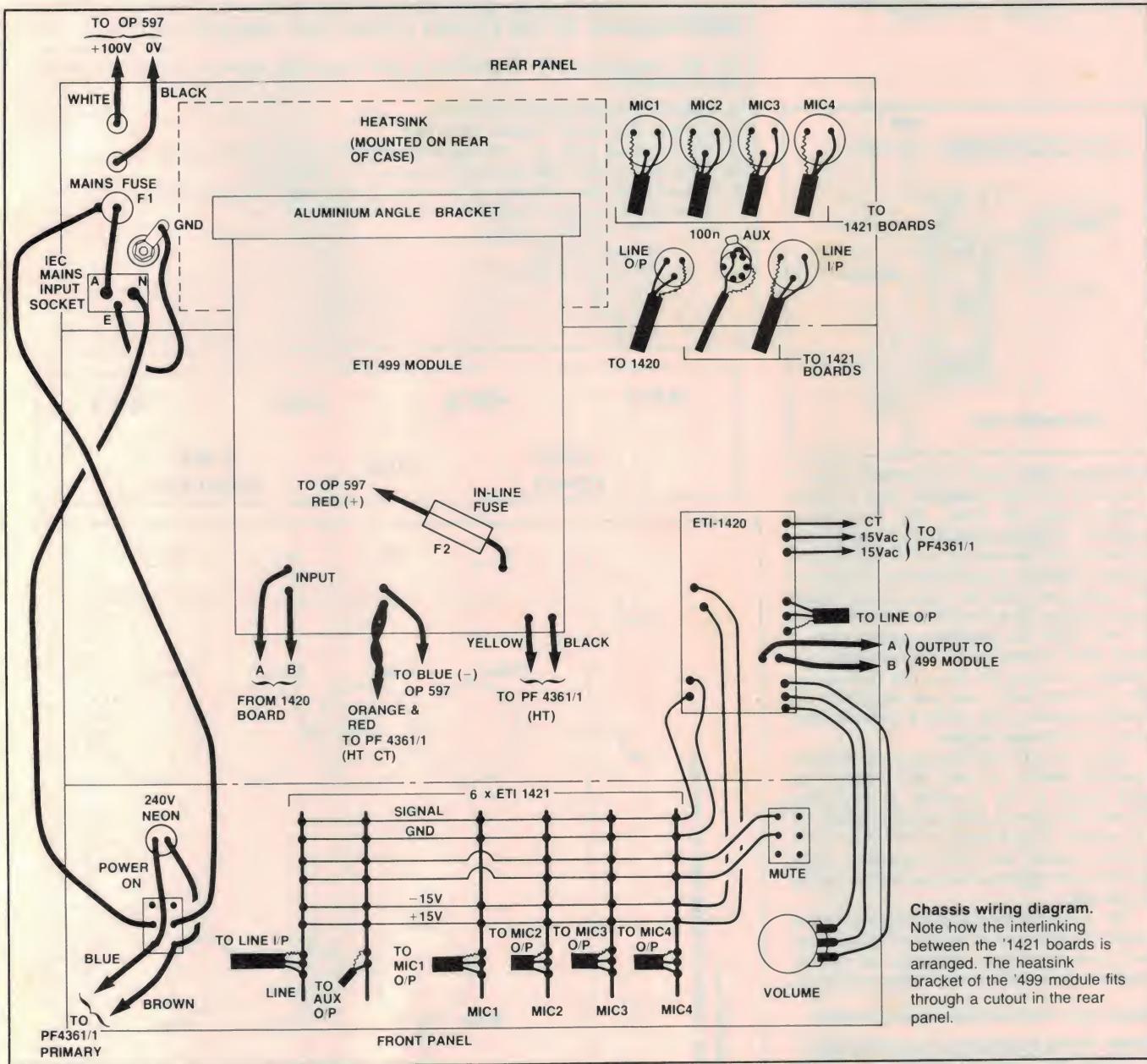
C1, C2 1000µF 25 VW RB
Electros
C3, C4, C5, C8 4µ7 25 VW Tantalum
C6, C7 22 pF Ceramic
C9 2µ2 25 VW Tantalum

Semiconductors

IC1 7815
IC2 7915
IC3, IC4 NE5534, LM5534
IC5 TL074, µA774
D1-D4 IN4001, IN4002

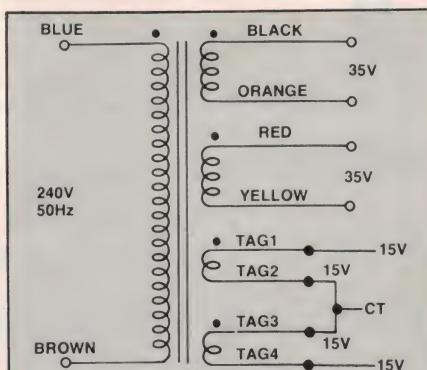
Miscellaneous

4 ETI-1421 Low Z balanced mic preamps
1 ETI-1421 Balanced line preamp
1 ETI-1421 Unbalanced aux. preamp
1 ETI-499 MOSFET power amp module



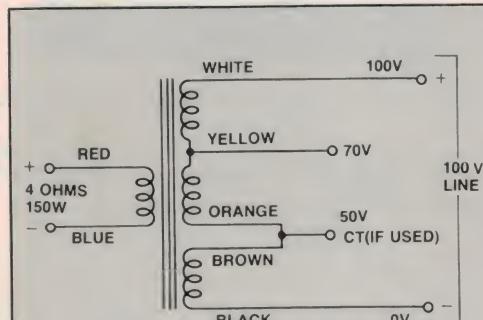
Chassis wiring diagram.
Note how the interlinking between the '1421 boards is arranged. The heatsink bracket of the '499 module fits through a cutout in the rear panel.

1 power transformer PF4361/1
1 line output transformer OP 597 (see text)
5 3-pin Cannon chassis sockets
1 3-pin Cannon chassis plug
1 5-pin DIN chassis socket
Radial fin heatsink, 225mm x 105mm (DSE H-3426)
1 chassis fuse holder 3AG
1 2A fuse
1 in-line fuse holder
1 8A fuse
2 toggle switches DPDT 250 Vac
1 Euroconnector 3-pin mains male chassis socket
1 250 Vac neon in bezel
18 small knobs
1 large knob
19" by 5" rack box
ETI-1420 Front panel
Brackets to mount transformers, etc.
Heavy duty hook-up wire
2 screw terminals (for 100 V line)
Balanced microphone cable
Price estimate: \$200-\$220



PF4361/1 CONNECTIONS

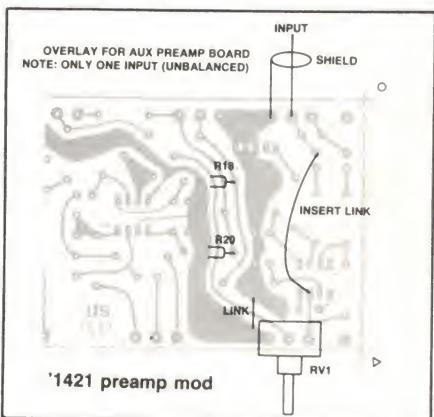
The lead-out wires from the power transformer are colour-coded as shown here. This should help you identify where the wires terminate on the '499 and '1420 modules. The high tension centre-tap (HT CT) is formed by joining the orange and red leads at the '499 pc board.



OP597 CONNECTIONS

Colour-coding for the lead-out wires on the 100 V line output transformer. The orange and brown wires must be joined. Note that this transformer gives a true balanced 100 V line output, unlike an autotransformer (as used on the ETI-498 Outdoor PA). The white and black wires go to the output terminals on the rear panel, above the mains fuse.

Project 1420



MODIFICATIONS TO THE ETI-1421 PREAMP FOR THIS APPLICATION

For this application, we recommend a few component value variations and other, minor, changes.

1. Delete C7 and replace it with a link.
2. Change R12 and R13 from 10k to 4k7.
3. R6 should be 150k, not 100k (parts list correct, circuit value in error).
4. Note that, for the LINE and AUX preamps, R6 is different.
5. Should there be a shortage of the 100k/A pots used in the tone controls, use these alternative component values.

RV2 and RV3: 250k/A

R7 and R8: 82k

R9 and R10: 33k

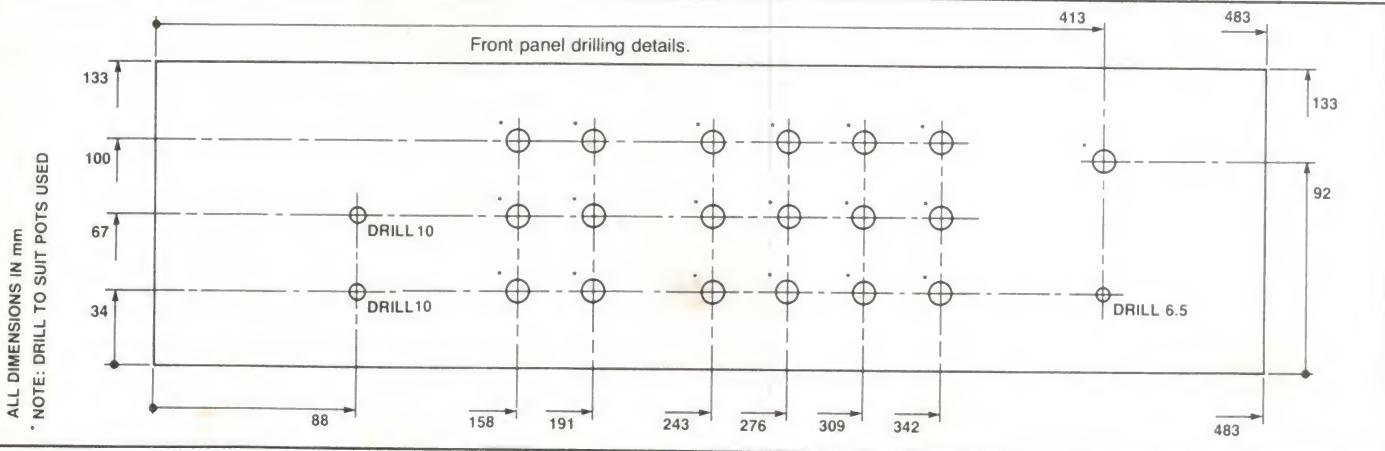
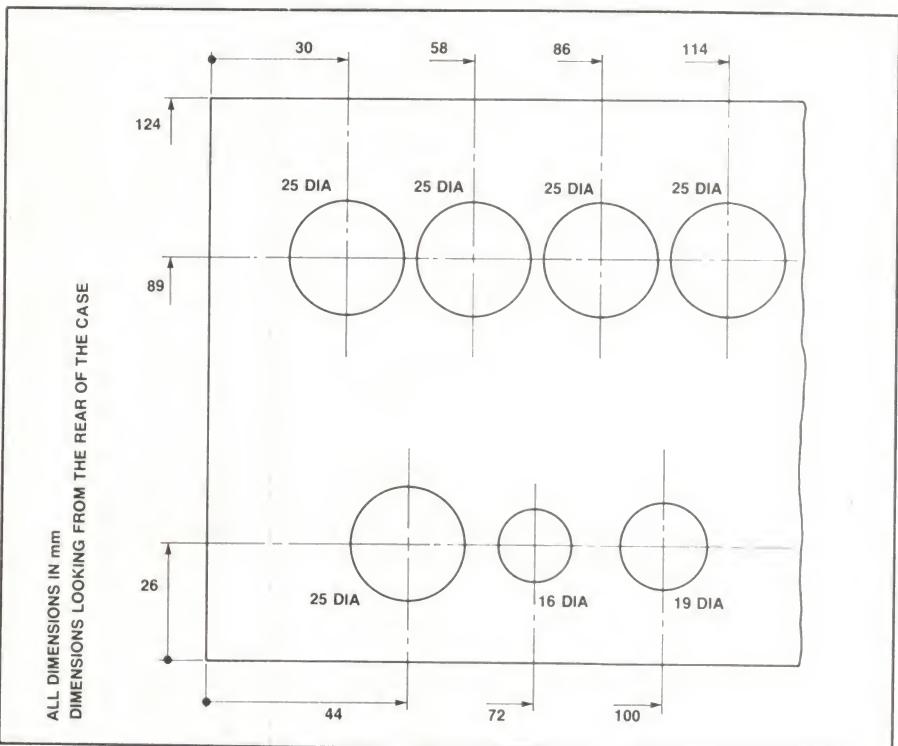
R11: 8k2

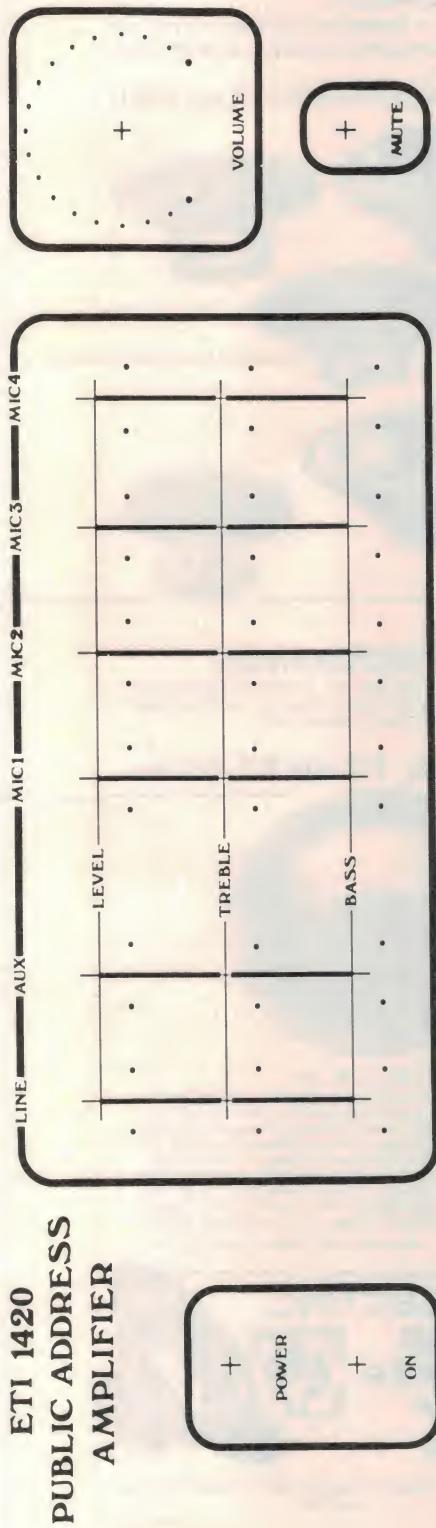
C5: 2n7

C6: 1n

MIC4 MIC3 MIC2 MIC1

LINE INPUT AUX LINE OUTPUT





ETI 1420
PUBLIC ADDRESS
AMPLIFIER

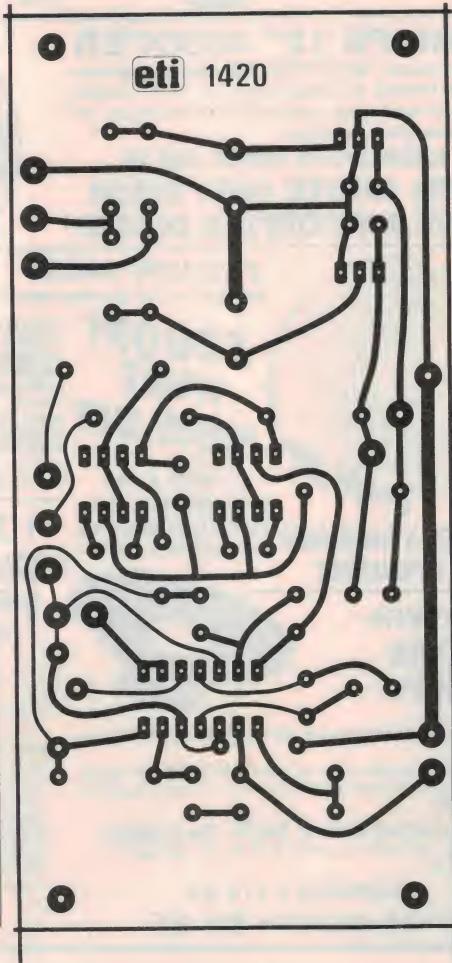
ly. The main advantage is that the cord may be completely removed and the amplifier carried without any trailing wires. The 'EURO' socket uses crimp style pins which are fixed to the wires and then pushed into the plastic moulded case where they catch. Whatever mains cord you use it is imperative that the metal case is connected to the earth pin through heavy duty green/yellow wire.

The back panel is completed by mounting the mains fuseholder near the 'EURO' socket and the terminals for the 100V line. The ETI-1420 PCB mounts on the side of the case near the volume control pot between the front panel and the OP597 transformer. I used 6BA screws and 6 mm spacers to support the board.

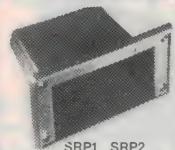
The OP597 is wound with an isolated primary winding designed for a 150 W into 4 ohms power amp — ideal for the ETI-499 module. Three separate secondary windings are provided to allow 50, 70 or 100 V outputs: the black-brown pair deliver 50 V, the orange-yellow pair deliver 20 V while the yellow-white pair deliver 30 V. Note that the two wires marked yellow are brought out in one plastic sleeve. The yellow wires should be soldered together and insulated. Then do the same to the orange and brown wires. The 100 V output then comes from the black and white wires, white to positive. The primary positive is the red wire.

An in-line fuse holder is used in the power amp output wire to the OP597 to protect the power amp.

Left. Front panel artwork, 50% actual size.



AUSTRALIAN IMPORTERS



CLIFF

CH-1

CABINET HANDLE
102 x 48mm



SRP



PF-1

CABINET FEET
37mm



CH-2

LARGE
CABINET HANDLE
165 x 210mm



CF-1

CABINET CORNER



PCB SPACERS

12.5mm 19mm 25.4mm 31.7mm



TPI TERMINAL

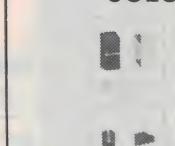
4mm, SCREW, 15A, 250V.A.C.



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8" 3 WAY SYSTEM

Superb 8" woofer with foam surround suspension and heavy magnet assembly with sealed back midrange and tweeter. System impedance 8 ohms. Power handling 40 watts rms. Crossover capacitors and connecting diagram and recommended 8" cabinet detail drawing supplied.

Cat. CS-2453 (2 required for stereo)

\$29.95/SET



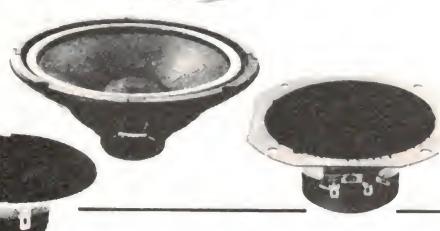
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Once again, a high quality 10" woofer with higher power, sealed back midrange and tweeter. System impedance 8 ohms. In addition a quality Pioneer 3-way crossover is provided at no extra charge. Connection instructions are also provided as well as recommended 10" cabinet plans.

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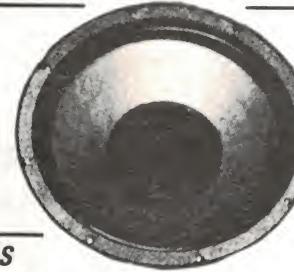
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We have made a MASSIVE SCOOP purchase of genuine quality PHILIPS European made 12" HI FI woofers. These are used in the fabulous ET14000 series kits. 100 watts rms power handling.

CATALOGUE PRICE \$99.50

THIS MONTH ONLY \$59.50

SAVE A WHOPPING \$40.00!!



8" CEILING GRILLES

- Will they ever be this cheap again?



PRICES INCLUDE TAX

Once again - a massive scoop purchase with a difference. We have purchased a very large quantity of reject grilles. They are rejects because they have small flaws in the mouldings. Most people however cannot pick the flaws if allowed to examine the grille. Imagine what the flaws look like *9 feet up* on the ceiling! Naturally we are offering a massive saving over normal units which we also sell. Exactly the same units (sans flaws) have been sold throughout Australia in the 10's of 000's. The perfect ones sell for around \$2.95 - at least one company sells them for well over \$3.00. PA INSTALLERS - GO FOR IT!

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WHAT
PRICE US?**

FROM 99¢
TAKES STANDARD
8" SPEAKERS



8" TWIN- CONE HI FI

20 watts rms with whizzer cone. Air suspension type. Low free air resonance.

Normally this speaker sells for around \$19.95. The Jaycar massive scoop purchase enables you to buy them this month at only \$9.95.

AN INCREDIBLE 50% SAVING!!

The stock WON'T LAST AT THIS PRICE - HURRY!!

Cat. CE-2330

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10" ELECTRIC GUITAR SPEAKER

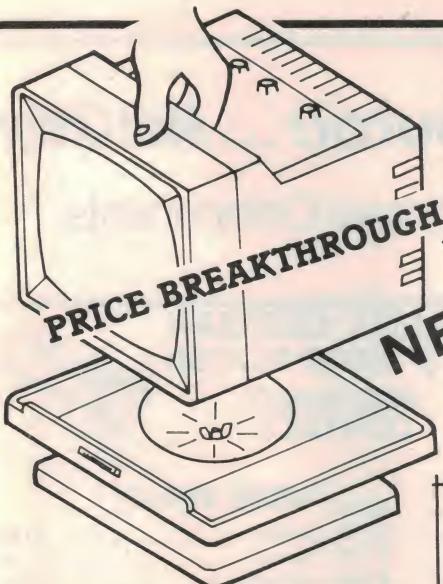


CATALOGUE
PRICE
\$39.95

Quality Pioneer brand - check the specs! Check the price!!
HURRY

Impedance	8 ohms
Voice Coil dia.	1 1/2"
Power Rating	60W (RMS)
Resonant Frequency	80Hz
Sensitivity	98(dB/W)
Response	80Hz - 7,000Hz
Total Flux	61,100 Maxwell
Flux Density	8,300 Gauss
Net Weight	1,540 grams

ONLY \$29.95



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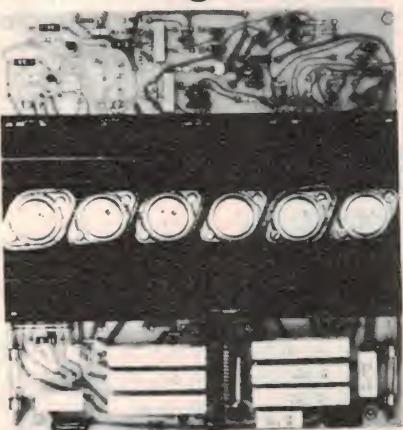
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FLOPPY DISK STORAGE CASE

Fantastic price breakthrough. A must for serious P.C. users. Will take up to 50 x 5 1/4" floppies in sets of 10. Compartments lift up and lock in place for easy identification of disk files. ABS resin case. Dimensions: 400mm long 180mm wide by 170mm high. Translucent plastic lid. Quality!
Cat. XC-4780

NEW

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\$59.95



PRICE SLASHED!!

300 WATTS OF MUSIC POWER!

Limited Stock Be Quick
(Kit Form)

For professional sound reinforcement, musician or home hi-fi, this one really delivers the power. A superbly designed power amp module that only needs a simple power supply, case, connectors and hardware to be up and running - at a fraction of the price of commercial units. See EA June 1980.

This kit includes all parts to build the module. Additional kits below provide the power supply and speaker protector. Team this with one of our 19" rack cases, a Sprite fan and some hardware, and you've got a high performance 300W mono amp ideal for any use. Specs are: Output power 300W rms into 4 ohms (200W into 8 ohms) - Frequency response 20Hz - 20kHz - 1dB - Hum and noise 95dB below 100W - Distortion below 0.2% at full output.

Module Kit complete Cat. KA-1115
WAS \$85 - NOW \$59

Power Supply/Transformer Cat. KA-1116
WAS \$79.75 - NOW \$59.00

Speaker Protector Cat. KA-1117
WAS \$12.95 - NOW \$9.95

MICROBEE DUST COVER

This great new, clear cover will keep dust and grime and all the nasties off your MicroBee. Contacts on the keys will last much longer. Can be removed in a moment. Antistatic treated to repel dust.
Cat. XA-5575

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SMOKE DETECTORS BACK!!

BARGAIN OF THE CENTURY
Once again we have made a scoop purchase of ionisation chamber type smoke detectors. When we had this product before we sold many thousands at our ridiculously low prices. We sold out of course but NOW THEY'RE BACK!! The smoke detector is completely self-contained, is round and measures a compact 115mm diameter and 40mm deep. Fixing screws and masonry plugs are provided along with 9V battery and very comprehensive instruction manual. The "Smoke Sentry" once sold for \$49 and frankly was a flop at that price. Despite the fact that every home should have at least one, people considered that their children and their own lives were not worth that amount. But now you have NO EXCUSE! Once again Jaycar has made a MASSIVE SCOOP PURCHASE of SMOKE DETECTORS below importers COST! We pass the savings on to you!

If you missed out before HURRY this time. Don't be disappointed!
Cat. LA-5090

1-9 Pcs

\$19.95

10+

\$17.95



NEW - NEW - NEW - NEW - NEW LOW COST 3 1/2 DIGIT LED

PANEL METER KIT build it yourself and save a fortune! ★ Massive 16mm high digits ★ Very few external components ★ Plus/minus 199.9mV full scale ★ Input impedance 10 to 12 ohms ★ Requires only 5-6V @ 150mA! ★ Guaranteed to reset to zero at zero input voltage ★ Auto reverse polarity indication ★ IC sockets included ★ Instruction sheet shows application ★ Notes to build Digital Thermometer, Capacitance Meter, Frequency Counter etc.

STAGGGGGGERING VALUE AT \$29.95

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ONLY \$24.95

Cat. KJ-6670

COMPLETE WITH ATTRACTIVE BEZEL AND INBUILT FILTER!!

BARGAIN 4700 CAN CAPS

4700uF/40V quality Philips upright chassis mount caps. Screw terminals.
Cat. RU-6707

\$10 VALUE

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MORAY FLOW SENSORS BACK - BACK IN STOCK!!!

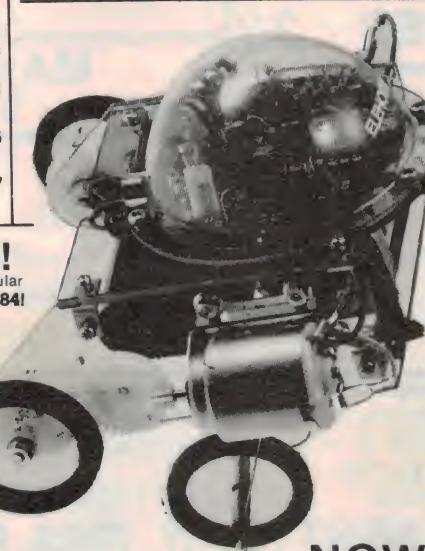
The original unit as used in the EA Car Computer (Aug '82) Due to pressure of demand another batch of genuine MORAY fuel flow sensors has been acquired. Despite devaluation of the Australian \$ and inflation, we can STILL bring them to you at our August 1982 price of \$59!! Each unit is individually calibrated and comes complete with data.

Cat. XC-2020

"T" piece for fuel bypass systems

\$59

\$3.95



PIPER MOUSE

This 'microbot' is powered by 2 DC motors that drive wheels. When special ultrasonic whistle is blown, the unit goes left, right, straight ahead according to your command. Complete, including perspex dome cover! Be a Pied Piper!
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\$34.95 \$5.00**

MEMOCON CRAWLER

This robot is controlled by a keyboard (which is supplied). The keyboard plugs into the robot. Up to 256 discrete commands can be entered into the robots memory (RAM). The robot will then move according to programmed instructions. Lights and a buzzer can also be programmed to operate as well.
Cat. KJ-6686

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We have secured another shipment of the two most popular Micro Robot kits. SEE REVIEW IN EA MARCH '84!

LINE TRACER ROBOT KIT

NORMALLY \$39.95

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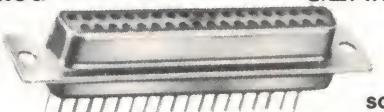
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(Founded 1976)

"D" Range Connectors

Gold plated
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9 way ADS 9L \$1.95
25 way ADS 25L \$4.30

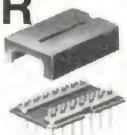
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socket

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A24P \$3.10
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1/4" rectangular 20 turn cer. met type
43P 100R, 200R, 500R, 1K,
2K, 5K, 10K, 20K, 50K, 100K,
200K, 500K, 1m all \$1.50
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100R, 500R, 1K, 2K, 5K,
10K, 20K, 100K, 1M all \$0.85
Precision 10 turn wire-wound
pot type 534, 500R, 1K, 2K,
5K, 20K all \$10.50
100K \$17.50
3 digit dial to suit 534, mod 15 \$25.50



E.C. POWER FERRITES

Includes 2 corehalves, bobbin and clamp

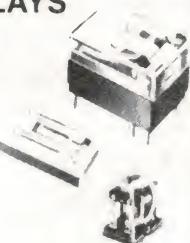


EC35 \$3.50 EC52 \$6.15
EC41 \$3.95 EC70 \$9.75

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Contacts 1 Amp, max voltage 120AC,
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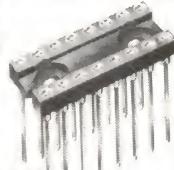
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PCB



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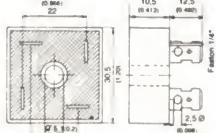


WIRE WRAP

AR6	\$0.68	AR6W	\$0.90
AR14	\$1.10	AR14W	\$1.85
AR16	\$1.20	AR16W	\$2.25
AR18	\$1.30	AR18W	\$2.38
AR20	\$1.62	AR20W	\$2.55
AR22	\$1.82	AR22W	\$2.75
AR24	\$2.05	AR24W	\$3.05
AR28	\$2.05	AR28W	\$3.25
AR28	\$2.12	AR40W	\$4.05
AR40	\$3.12		

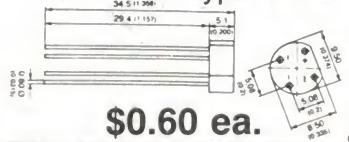
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35 Amp 400 PIV
Type 3504



\$4.75 ea.

1 Amp 400 PIV
Type WO 4



\$0.60 ea.

SUBMIN R. F. CHOKES



ALL
VALUES
50c

2.2	Microhenry	100	Microhenry
3.3	Microhenry	220	Microhenry
4.7	Microhenry	330	Microhenry
10	Microhenry	470	Microhenry
22	Microhenry	1	Millihenry
33	Microhenry	3.3	Millihenry
47	Microhenry	4.7	Millihenry

! SPECIAL !
Voltage Converter
TSC7660
for modems, etc.
\$3.80

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3 1/2 digit LCD DVM IC TSC7106	\$16.50	Superlow power 3 1/2 digit LCD DVM TSC7126	\$19.50
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Digital readout electronic scales

Part 2

Ian Thomas

THE FIRST PROBLEM with this project is getting the printed circuit board made. With all due respect to readers' undoubted skills in photo-lithography, the strain gauges really are just about out of reach of 'kitchen sink' technology. When I made the first simple one-beam test board I had no end of trouble with

- (a) taping up 20 thou tracks at 15 thou spacing to generate the artwork
- (b) making sure the photoresist had no pinholes and
- (c) trying to etch the board evenly on both sides.

As it was I managed to scratch the resist which cut about four tracks in the meander line pattern. I can say from experience it's a sod of a job trying to bridge the gaps with solder. Just the taping is a tedious enough job.

If you want to make your own board *I strongly recommend* that you do the artwork at twice full size and have it reduced. This way you can use '40-thou' tape and interleave it with '30-thou' tape for the spaces. When the complete strain gauge is taped, the 30-thou tape is removed and gives a very even pattern. The ends are then joined to give the meander line. This was exactly how I made the prototype artwork.

Since I didn't fancy taping separate artworks for both sides I used the same strain gauge artwork for both sides and overlayed it with the pattern for the electronics during photography. Dick Roodenberg of Gladesville (Sydney) was very helpful here and is *most* reasonably priced. You could probably photograph the artwork at the back of this article OK too, but really, it's not the sort of thing to be taped up one-to-one and have come out successfully. (Transparencies of the artwork are available — see 'Shoparound' this issue.)

Much the same argument applies to the board etching. Life really is too short to spend hours fiddling with chemicals to have a damn great scratch across the strain gauge grid and a ruined board. It's also absolutely essential to use '½-ounce' copper to increase the strain gauge resistance.

Most of the ready resist-coated boards use '1-ounce' material which is not good. Probably the easiest way is to buy a ready-made board and cut it out yourself or photograph the artwork and have a board made.

Needless to say it absolutely, totally, utterly *essential* that you use glass epoxy board. If you tried to use paper phenolic the cantilevers would probably break off the first time you sneezed at them. They just would not be strong or springy enough



Now we get down to the 'nitty gritty' of constructing the instrument. No fancy tools are needed, but a fret saw or small jigsaw makes cutting the pc board to shape easy.

(don't forget the base material of the board is the "reference spring" of the whole scale).

Once you've got a board, by whatever means, the first thing is BE CAREFUL OF THE STRAIN GAUGE PATTERNS. You've got to be continually aware that *they are easy to ruin*. If you've just got a board with the outside guillotined off square the first thing is to cut out the load beams and, in the centre, the piece of board that is used to mount the weighing pan. I used a piece of hacksaw blade with a handle made from masking tape for this job. To separate out the three beams there are three triangles with 30°, 30° and 120° vertices to be cut out, each of which requires three cuts.

To start each cut, drill five 3 mm dia-

metre holes using the pads provided. The holes may not run together completely so, using fine long nosed pliers *gently and carefully* break out the material between them. Then, holding the board between two pieces of softwood in a vice, cut along the copper tracks that delineate the edge of the board. You should leave most of the track in place with the hacksaw. After you've made the three cuts for one triangle and the bulk of the excess board has been removed, then dress the cut edges back with a fine warding file. You've got to cut right into the corners to ensure that all the strain gauge is flexed; for this I bought a fine needle file shaped in a shallow wedge.

During all this, never hold the board directly in the jaws of the vice or you will ►

Project 1523

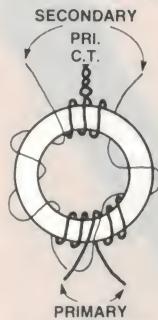
cut through the strain gauges. Repeat the process for the other two triangles and when you're dressing them off be sure to dress back the centre bit as well. When this is finished you should have removed all of the copper track that marks the edge of the board *but no more*.

The last step is to cut along the ends of the beams to free them up and also free the centre piece as well. Clean everything up with the warding file and that's the tricky bit finished. The next step is to drill all the holes. About a 0.8 mm drill is fine here and it's a good idea to run through all the holes first with the fine drill then open out the larger ones later.

The base plate, as mentioned, is 2 mm thick aluminium exactly 160 mm square and when you drill the nine holes for the mounting pillars it's a good idea to clamp the base plate to the board and drill both together. I've found that no amount of careful measuring is quite as good as using a template if one is available. For this reason there are no dimensions given for the nine holes.

Once the fine holes are drilled you can

TOROID WINDING DETAILS



Toroid: Neosid #28-680-36 or #28-080-36
 Primary: 4 m of 0.33-0.35 mm enamelled copper wire, closewound on 120 turns, centre-tapped.
 Secondary: 10 turns of 0.5-0.64 mm enamelled copper wire, wound over primary.

Take the 4 m of primary wire and double it in half. Twist the fold for a good 30-40 mm to make the centre tap. Commence winding from the centre tap, laying on 60 turns winding in one direction. Then wind on the other half — winding *in the same direction*. Lay the turns close to one another on the inside of the core and the windings should fit neatly. Use sticky tape to hold down the two ends when you're finished.

Tackle the secondary next. Start the winding adjacent to the primary centre tap. Wind on 10 turns *in the same direction* as the primary. Distribute the turns evenly around the circumference of the toroid.

Note that, in the drawing above, the primary winding has been shown in a thicker line than the secondary for reasons of clarity. The secondary winding actually uses a heavier gauge wire.

PARTS LIST — ETI-1523

Resistors	..... all 1/2W, 5% unless noted
R1	..... 33k, 2%
R2	..... 1M
R3, R4	..... 390R
R5, R6	..... 2k2, 2%
R7	..... 47k, 2%
R8	..... 22k1, 1/2%
R9	..... 22k6, 1/2%
R10, R11	..... 22R, 2%
R12, R14	..... 1k00, 1/2%
R13	..... 7k5, 2%
R15	..... 100k, 1/2%
R16	..... 10k, 1/2%
R17	..... 10R, 2%
R18, R19	..... 47k, 2%
R20, 21, 22, 23	..... 475k, 1/2%
R24, R25	..... 22k1, 1/2%
R26, R27	..... 47k5, 1/2%
R28	..... 8k2, 2%
R29	..... 200R, 2%
R30, R31	..... 100k, 2%
R32	..... 39R
R33, 34, 35, 36	..... 1k
R37, 38, 39, 40, 41,	
42, 43	..... 100R
R44	..... 3R3
R45, R46	..... 15R
RV1	..... 1k cermet trimpot, horizontal pc mount.
RV2	..... 50R or 500R linear pot., cermet (see text)
Capacitors	
C1	..... 6p8 ceramic plate
C2, C3	..... 1n metallised film
C4	..... 10μ/16 V electro.
C5, C6	..... 470p ceramic plate
C7, C16	..... 100μ/25 V RB electro.
C8, C9	..... 10μ/10 V electro.
C10, 11, 12, 13	..... 1μ metallised poly.
C14, 15, 17	..... 100n ceramic bypass
C18, C19	..... 2200μ/16 V axial electro.
C20, C21	..... 470n metallised poly.
Displays	(FRONT VIEW)
10 9 8 7 6	1 SEG e 2 SEG d 3 COMMON 4 SEG c 5 dp 6 SEG b 7 SEG a 8 COMMON 9 SEG f 10 SEG g
1 2 3 4 5	
CAPACITORS	
electrolytic	
tantalum	
DISPLAYS (FRONT VIEW)	
10 9 8 7 6	1 SEG e 2 SEG d 3 COMMON 4 SEG c 5 dp 6 SEG b 7 SEG a 8 COMMON 9 SEG f 10 SEG g
1 2 3 4 5	
TO-92 BC337 PINOUT	
NOTCH OR SPOT AT THIS END	
TO-220 78xx +ve voltage reg.	

C22 220p metallised poly.
 C23, C26 39μ/10 V tant.
 C24, C27 100n ceramic bypass
 C25 330μ/6 V tant.

Semiconductors

Q1, 2, 3, 4, 5, 6 BC337
 IC1 4001B
 IC2 4013B
 IC3, 5, 6 CA3240E TL082 etc.
 IC4 4053B
 IC7 MM74C935N, ADD3501
 IC8 7805
 DSP1-4 FND500, HDSP-5503 or equiv.

Miscellaneous

TR1 Neosid toroid core type 28-680-36 (nylon coated) or 28-080-36 (plain) wound with about 4 m of 0.33-0.35 mm enamelled copper wire, plus sec.
 TR2 Ferguson PL12/5 VA pc mount transformer

ETI-1523 (double-sided) and '1523ps (power supply) pc boards; case — Birbox model 6007 (Jaycar Cat. No. HB-6240); Scotchcal front panel; 6 mm or 8 mm dia. by 80 mm long bolt with two nuts; six 30 mm wide brass hinges; 150 mm dia. 'Decor' pot stand; 2-way pc mount terminal block; mains cable, cable clamp grommet and mains 3-pin plug; two knobs; hookup wire; heavy gauge aluminium plate, 160 mm square; nine brass standoffs, 25 mm long, tapped 4 BA; bolts to suit (18 off); 100 mm shielded cable and 100 mm of twin shielded cable; four 12 mm long tapped spacers with bolts to suit; etc.

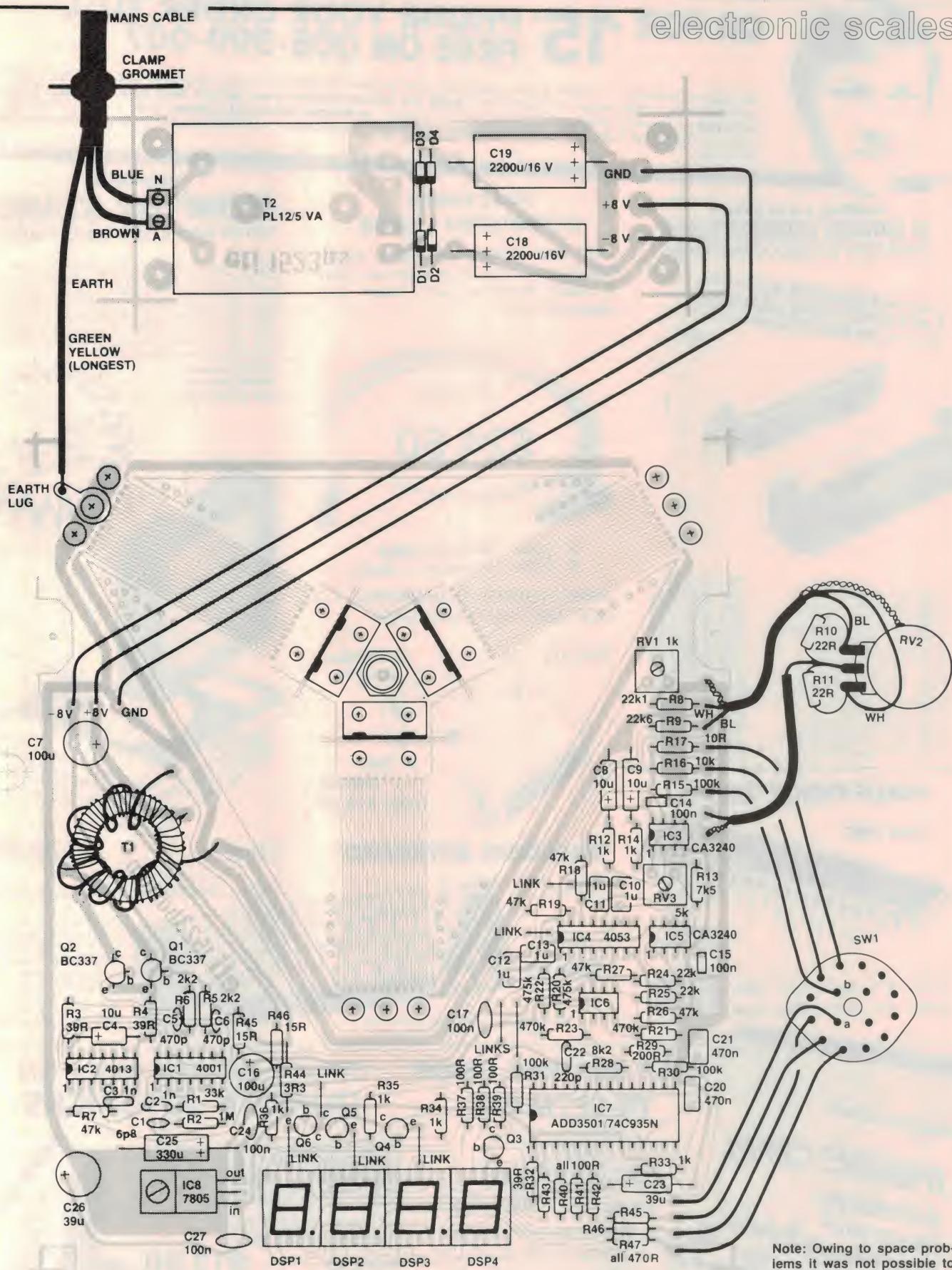
NOTE: The main, double-sided, pc board requires **1/2-ounce** copper, not the usual one-ounce variety.

Price estimate: \$105-\$120

1	V _{cc}	e	28
2		f	27
3	d	g	26
4	c	GND	25
5	b	DIGIT 1	24
6	a	DIGIT 2	23
7	OVERFLOW	DIGIT 3	22
8	CONV. COMPLETE	DIGIT 4	21
9	CONV. START	F _{out}	20
10	SIGNAL	F _{in}	19
11	V _{ff}	V _{ref}	18
12	V _{in(-)}	SW1	17
13	V _{out(+)}	SW2	16
14	V _{fb}	ANALOG GND	15

open out the nine mounting holes with a 9/64" drill and while you're there, drill the holes in the mounting plate as well. The last step is to cut out the notches for the box mounting pillars if you're using the same box I did (Jaycar Cat. Nos. HB-6240/1/2). Unless you're fortunate enough to have a

split rail power supply, the first thing you'll have to build is the power supply board for the scales, so you've got something to work with. This is pretty straightforward though. Just drill all the holes to about 1.6 mm (1/16"), except for the mounting holes which are, once again, 3.6 mm (9/64").



Note: Owing to space problems it was not possible to print full size artwork in this issue. (See Shoparound page 154)



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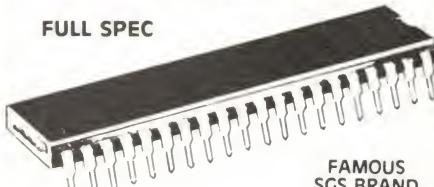
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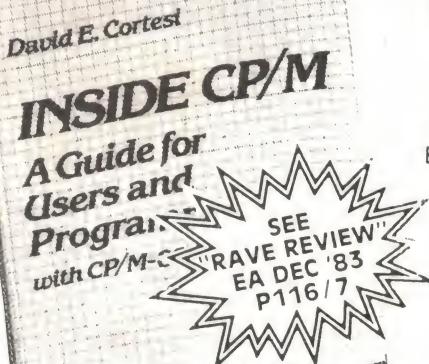
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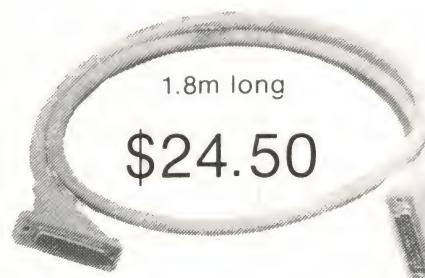
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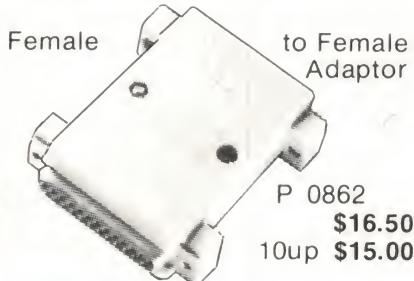
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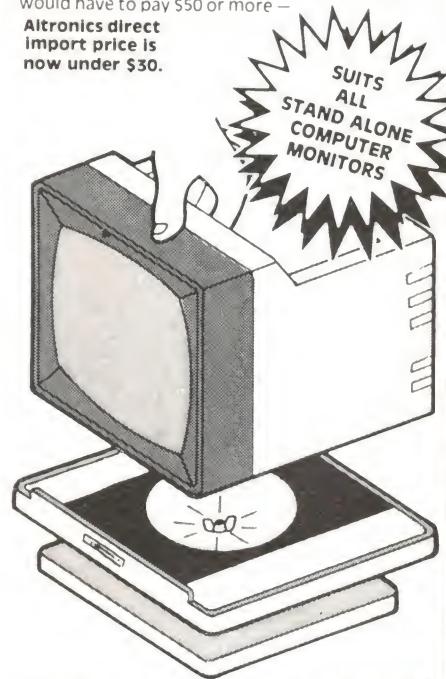


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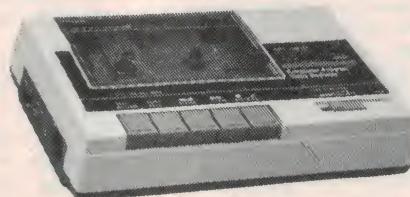
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(See Review ETI AUGUST 1983)

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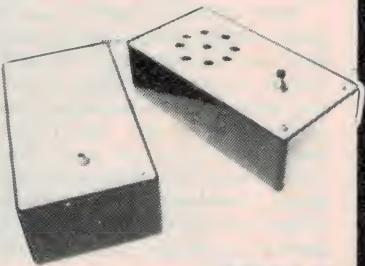
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LOW NOISE EARTHING

It can't be emphasised too much how important a proper approach is to earthing in sensitive instruments. Books could be written about it (and almost certainly have). If it is done correctly things work pretty painlessly, but if the rules are broken you've got Buckley's chance of sorting out all the problems. To give you an idea of how this design was approached, it's interesting to look at the layout of the board and explain why certain things were done.

One of the first rules is that if you have a known crud generator (here we have three beauties!) then the crud must be contained and not allowed to insinuate itself on supply lines. In this case the three are the CMOS oscillator and divider (not so bad), the inverter itself (a truly magnificent spike generator) and the digital part of the DVM chip (a true recipe for disaster!).

If you look at the layout you will see that positive and negative rails for the inverter feed nothing else but the inverter and are run straight to a large filter capacitor before going anywhere else. This means any high level ac currents are contained within the inverter area itself and aren't allowed to impose themselves on the supply rails for the rest of the circuitry. The inverter was deliberately run from the positive and negative rails so no spikes had a chance to get onto earth lines.

Much the same applies to the CMOS oscillator except that the supplies are decoupled by resistors and have their own massive bypass capacitor. To be quite candid I whoopsed here in the prototype and didn't bother with the resistors but the electrons have absolutely no respect and the spikes from the oscillator got everywhere. The decoupling resistors went in!

The third and worst noise generator is the DVM chip itself. National know their stuff so there are two earths on the chip to enable all the bad things to be kept in their place. You will see on the layout that the earth for the digital section of the DVM starts at the input to the whole board and runs down the side of the board away from any sensitive areas to the 5 V regulator and display. It is connected to *nothing* except the digital circuits and their associated filter capacitors.

This earth can be thought of as the "dirty earth" and it is unthinkable to take it anywhere near any analogue circuitry (the term "unclean" is totally appropriate!).

Even with all this care it was still necessary to bypass the 5 V rail with a monster 330 μ F tantalum capacitor plus a not-so-monster one on the 8 V input to contain the crud. National Semiconductor recommend a special 5 V regulator with very good high frequency attenuation to get away from the expansive tantalum capacitor but they aren't easy to get.

The "clean" earth starts from the common node of the two strain gauge bridge arms and runs straight around to the linear section of the circuit. It's kept as far away as possible from all the bad, dirty digital stuff and is connected to one point which is the reference earth for the high gain ac amplifier (that's where the two 10 μ F capacitors are connected).

The secondary of the inverter is floating and connected only to the resistors which form the other half of the bridge via two tracks that run parallel, and as close as possible to the "clean" earth. Even here it is not assumed that the two ends of this earth are at the same potential; it is merely hoped that the potential difference is the same for the signal lines as for the earth line.

As the two gain blocks in the amplifier have nearly the same earth (they are only 5 mm apart) no contaminating signal should be able to get in here. The amplified ac signal is not considered to be referred to any earth but is only a voltage difference between two capacitors. It would probably work OK to not connect the "earth" ends of the capacitors to anything but I didn't try it. The voltage difference between the two capacitors is then connected to the differential amplifier discussed earlier whose reference earth is — lo and behold! — the reference earth for the DVM.

There are no absolute earths at all in the system but only local earths which tie things together where they matter. If you decide to build the scale and want to see that this isn't all theoretical, just try shorting the analogue and digital earths of the DVM together and watch the whole thing fall in a heap (it isn't destructive, just educational!).

Assemble all the bits being sure to get the diodes and capacitors in the right way. I think it's an investment in good health and long life to use a mains screw-type connector to get mains onto the board — they're readily available at Jaycar and other electronics suppliers — and could save a nasty accident with frayed bits of copper.

After you've completed assembly of the power supply board *tape-up the tracks that have mains on them* or cover with Araldite, Silastic, or the like. Then connect a three-core mains lead to the input connector and power it up to test. The Ferguson mains transformer gives out more than its rated voltage under no load but this is normal — I found I got about ± 10 volts. Turn the mains off and pull out the plug as well; I have little faith in electricians putting the switch in the active lead!

The next step is to wind the toroidal transformer. The core is a Neosid type 28-

680-36 (nylon coated) or 28-080-36 (plain) and either will do. You will need about four metres of 13 or 14 mil (0.33 to 0.35 mm, say 28 B&S) enameled copper wire for the primary winding. Try and get 'Solder-eze' or 'Leumex' enamel which can be stripped with a soldering iron to make things easy. Some stores that have high expenses like helicopter fuel sell wire that has to be stripped with emery paper and it's a damn nuisance. Fold the wire double and twist the fold tightly for about 20 mm or so to form the centre tap.

The actual winding should be done in a room where there are no dogs, cats, rabbits, guinea pigs or small children as you'll have wire all over the place and things just love to get tangled in it! Thread one end of the wire through the core until you reach the centre tap, then commence winding turns through the core and laying them *neatly* hard against each other. As there is only

just enough space for the required 120 turns you must make absolutely sure that each turn is hard up against the next and that each is nice and tight. It's easiest to wind one half of the toroid completely first then wind the second half. Once the wire has been partly wound onto the core it gets easier to handle but always be careful not to allow the wire to kink. This is particularly prone to happen just as the last bit of a winding is being pulled onto the core and once kinks are in they are very hard to get out.

If by some terrible miscalculation you wind 60 turns on one side then find that you can only fit on 55 or so on the other side don't despair. A few turns more or less doesn't matter. The important thing is that there must be *exactly the same number of turns both sides of the centre tap*. Not even one turn difference is allowable.

As a matter of interest, the toroid I wound (or to give credit where credit's due — my wife) did have a one turn difference and it produces a very noticeable asymmetry in the output waveform. As an aside, this is because each side of the winding is switched on for exactly the same time and if the number of turns is different the only way the core magnetising current can balance up is for the core to partially saturate on one side; which is exactly what happened.

After the primary winding is completed solder the twisted centre tap right up to the winding (if you do it before it makes it too easy to break the wire), then tin the two ends of the wire up to where they go onto the core.

Winding the secondary is rather more tricky but a lot easier. It is very important that the secondary be wound in the correct polarity. People hold toroids in all sorts of ways when winding them so it's hard to know just how the primary was wound, but the important thing is for the secondary to be wound in the same sense as the primary. That is, if you wound the primary with the wire through the toroid towards you, do exactly the same for the secondary. The transformer is tested before it can do any damage but it's nicer to get it right first time (up yours, Murphy!).

The secondary is only 10 turns of something stouter wire than the primary, 20 to 25 mil (0.5 to 0.64 mm, say 22-24 B&S) wire is fine. At a pinch you could use the same size wire as the primary but it makes things awfully hard to tell apart. Start the winding a few millimetres away from the primary centre tap and wind away from it evenly distributing the 10 turns around the core so that the last one puts you a few mm on the other side of the centre tap. Tin both ends of the secondary and that's the end of the tedious stuff.

In order not to have any spectacular and expensive accidents it's best to assemble and test the board in sections. Before you start soldering on the board though, a word of warning. This is only $\frac{1}{2}$ -ounce copper on

the board so it's a lot easier to damage than normal 1-ounce boards. Take it easy with the soldering iron.

Starting with the strain gauge drive circuit, ICs 1 & 2, assemble the complete circuit up to the two toroid drivers, Q1 and Q2. Also assemble the input filter capacitor C7 and don't forget the driver power supply filter resistors and capacitor. Then connect up the power supply board you've already built via three pieces of suitably-coloured wire about 200 mm long, taking care that you get the polarity correct. Then check that the polarity of the electrolytics and ICs are correct (both will tolerate reverse polarity for about five nanoseconds!).

Then plug in your carefully tested and *mains protected* power supply and turn it on. Quickly test that the supply rails are both up OK and that nothing has burst into flames. Then, if you have a CRO, check that there is a square wave at about 5 kHz on the two input pins, 12 and 13 of IC2 (the CD4013). If you don't, then check that the voltage on both pins is $0 \pm$ about 1 volt. If so, then probably all is well. You should get the same answer on pins 10 and 11 of IC1, the transistor drive gates.

Now comes the interesting bit, namely, connecting up the drive transformer. At this stage it is prudent to leave the leads long until you are sure that all is well. First, insert a piece of wire, about 30 mm long, and solder it to join the earth point which is common to the two strain gauges. Leave most of it sticking out the top of the board as a convenient earth test point. This point is about 30 mm South-West of the power input if the centre of where the display goes is due South and right on the inside edge of the board.

Next, using your trusty ohmmeter, check that you don't have trouble with the strain gauges. They should measure between 10 and 12 ohms for each side, an open circuit means you've got trouble. If by some horrible mischance you do have an open circuit then you'll have to find it by visual inspection (a magnifying glass will almost certainly be necessary). Try to repair the damage with a piece of fine wire and solder. On the first test board, I did have an open (read several) and I found it almost impossible to bridge the gap with solder. The gaps that I bridged went open circuit under load (both tensile and current). A bit of wire is safer.

If all is well, connect the centre tap of the transformer to the point nearest to the earth point and the two ends of the primary to the pads connected to the transistor collectors (solder on the wiring side — the top don't go nowhere!).

Then power up the board again and listen carefully (*really!*). You should hear a faint but distinct whistle from the toroid due to magnetostriction as it is cycled. If not, there is something wrong with the transformer or drive transistors. If all is well proceed to make sure that the polarity of the drive to the strain gauge is correct.

IAN THOMAS — a short biography

He was raised in Sydney's outer western suburbs (Penrith) in the days before the urban sprawl had reached out that far and Penrith still retained some of the character of a country town. After completing high school at Penrith High he went on to Sydney University to study Electrical Engineering in 1963. After two successful years he took the obligatory year off and transferred to the Science faculty to obtain his B.Sc in 1965. He transferred back to Engineering in 1966 and in 1967 completed his Engineering degree.

In 1968 he was employed by AWA in their Research Laboratories at North Ryde as a design engineer. Since then he has been working at North Ryde in various areas and has made full use of the vast opportunities for obtaining experience in almost all fields of electronics. His experience includes 18 months designing integrated circuits (actually laying out the emitters, bases, etc which is invaluable in explaining some of the less desirable unpublished characteristics of commercially available ICs!).

Since his boyhood Ian has been fascinated by electronics and from the day he actually heard noises from his first crystal set (using a real piece of galena — he's a purist at heart) he was doomed to his current career. He's always felt that his work should be a source of fun as well, so his home has strange machines readily available to perform menial tasks.

His approach to design is the same as his approach to life — decide what is really needed then do it with no consideration to the currently accepted norms and fashions. This is well illustrated by his attitude to a tidy work area (it isn't). When he can't find something he tidies up until he finds it, then stops and carries on with what he was doing. This system forms a self regulating arrangement where the exact optimum time is spent maintaining order so things are neither so chaotic that all progress ceases nor so neat that flicking solder from the iron becomes a major crime.

After nine years at AWA Ian decided enough was enough so far as working was concerned, so he emptied out his bank account and took off overseas for a year wandering around the world. For the whole year he saw nothing whatever of electronics (there isn't a great demand for remote controlled toilet flushers 15 000 feet up in the Himalayas). After he returned he was drawn as if by some horrible fascination (and the dollars!) back to AWA North Ryde.

Since then, he has continued to learn new tricks and further develop old ones with AWA's backing. Last year he decided that all the toys he'd built for himself owed him something, so he approached Roger Harrison to ask about the financial rewards for becoming a part time writer and project developer. After a ritual period of sordid haggling (Roger, you didn't stand a chance — you were up against skills developed in Indian bazaars!) an agreement was reached and the first article was written which appeared in last month's ETI (Project 275, Bathroom Strip Heater Time-out).

Since his return to Australia, Ian has spent most of his time developing microprocessor-based audio test equipment for the broadcasting industry, which introduced him to the principles of active filter synthesis. This interest has remained as a hobby and he often spends a recreational evening playing with such wonders as Jacobian elliptic integrals on his calculator. More recently he has become involved with RF power amplifier design, and has already designed a 25 watt 440 MHz amplifier for ETI. He is now toying with a 100+ watt aether bender on the same band.

Ian's pet peeves include non-cooperative public servants, Australian electronic component suppliers who don't carry stocks and editors who delay payment for articles (hint!). His deep loves include a nice cold schooner with condensation running down the side, Mel Brooks movies and, most of all, his beautiful Thai wife.

If you have a CRO this is dead easy. The output of Q1 (the inside transistor) and the top input to the strain gauge should be in *antiphase*. Measure the polarity of the two secondary leads and label them "IN" and "ANTI" or somesuch. If you don't have a CRO, a high impedance voltmeter set to ac will do fine. Measure the voltage between the collector of Q1 and the two secondary outputs. One should measure about 15 V and the other about 18 V. The higher voltage lead is in antiphase and the lower is in phase. Solder the two secondary leads onto the board and make sure that there is no problem, then shorten up all the wires and mount the toroid tidily on the board. It's a good idea to stick it down with some silicone stickum (e.g: Silastic) so things can't move around and break wires.

Having survived this, you can assemble the ac amplifier area of the board. Insert ICs 3, 4, 5 and 6, making sure they are in the right way and then assemble all the components around them. The type of op-amps you use isn't that important just as long as they're FET-input devices. Make sure that the polarity of the two electrolytics is cor-

rect, not so much because reverse polarity will damage them (it's only about 5 mV) but because the cans may capacitively pick up noise if you reverse them.

Wire in the trimpot RV1 and then connect up the two 22 ohm resistors R10 and R11 between the centre tap of the pot and the two ends. Alternatively, if you can get one, use a 50 ohm cermet pot, whereupon R10 and R11 are unnecessary. Connect the pot to the board using about 100 mm of two-core screened lead (this prevents capacitive pickup to the input).

You're now ready to see if you got the polarity of the drive transformer secondary correct. Power up the board again and make sure that all is well then measure the dc volts on the output of IC6 pin 1. If it reads about +2 V all is well, but if it reads -2 V then you blew it and got it backwards!

Before you start reversing windings from the drive transformer it's a good idea to check that the ac amplifiers are working OK by monitoring pin 7 of IC6. You should be able to adjust this to zero by adjusting the trimpot RV1; RV2 will give fine adjustment.

As a last check, hold the board firmly and bend one of the strain gauges away from the components. The output of pin 7 should go positive (fast and far!). If pin 1 is negative and pin 7 moves negative, then merely reverse the secondary winding of the drive transformer and all is well. If you can't zero the output try shorting the input to the ac amplifier, this should bring pin 7 of IC6 close to zero. If not, you've got problems with the amplifier or synchronous switching circuit. Find and fix is all I can offer.

If all is OK, then turn off the power and carry on to assemble the DVM part of the circuit. Start by assembling the 5 V regulator and all its associated capacitors. Turn it on and check that it works OK before assembling the rest of the DVM section (the DVM chip is relatively expensive and it would be so aggravating to cause one to disintegrate). Then carry on and assemble the rest of the board including the displays.

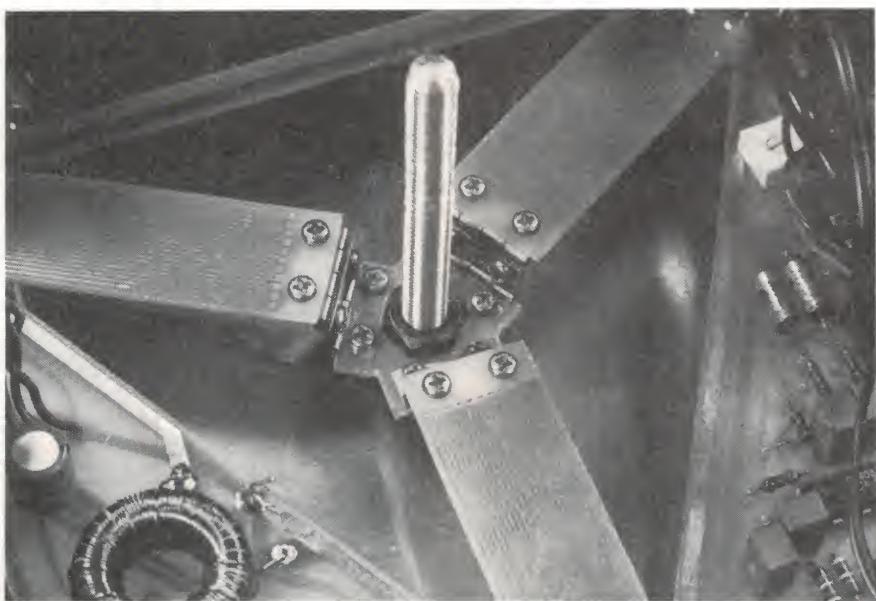
Now turn it on and see the pretty numbers come up! It'll probably come up with '000' or '0FL' depending on whether the zero set is too low or too high. At this stage it isn't worth bothering with the decimal point or gain switching as there's plenty to do yet. Check that you can in fact adjust to zero OK, just to be sure then you can start on the mechanical stuff.

Mechanicals

The first thing to do is prepare the case to accept the board. You will find that there are six totally useless little mounting pillars moulded into the bottom of the case. Remove them. I used a wood chisel and hammer, which worked fine. Clean the bottom of the case off smooth then take the piece of sheet aluminium and measure out the notches needed to clear the mounting posts in the case. The two pairs of groups-of-three holes go in the rear corners of the case. Cut out the notches and make sure that the plate fits comfortably and flat in the bottom of the case then hold it so there is about 2 mm clearance along the sides and at the back and drill three or four holes right through the plate and case. Anywhere will do as long as they don't come within 5 mm of the holes already drilled for the mounting pillars. Use a drill the right size so self-tapping screws will cut a thread properly, then open out the holes in the case to clear the self-tappers.

Next, countersink the nine board mounting holes deeply on the opposite side to that of the board and mount the nine 25 mm spacers on the mounting plate. Make sure that the screws are tight and you've finished that bit.

The next thing to assemble is the mounting for the weighing pan and post. Open out the six holes at the ends of the cantilever beams with a 3 mm (1/8") drill and repeat the process with the epoxy glass centre piece. Also enlarge the hole in the centre piece to clear the centre post that supports the weighing scale. Next come the hinges. Screw the hinges together in pairs back-to-



View of load assembly. Showing how the pc board centre piece and the cantilevers are coupled via the brass hinges.

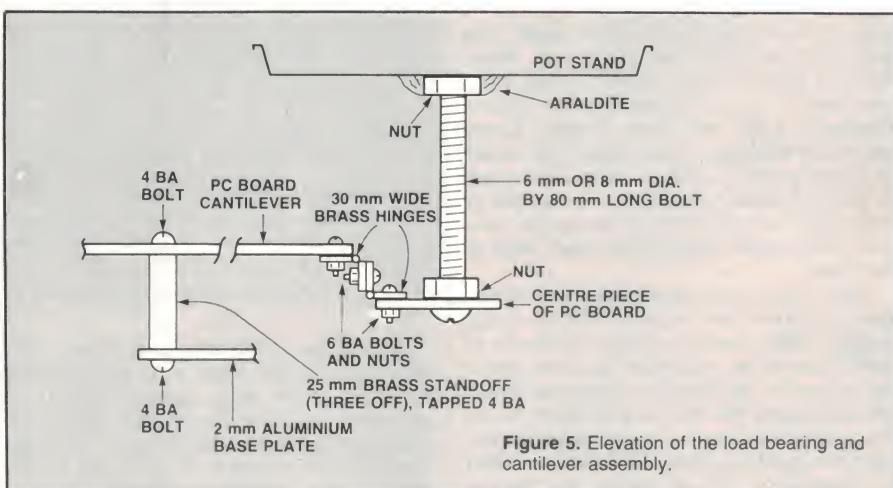


Figure 5. Elevation of the load bearing and cantilever assembly.

back, as shown in Figure 5, with 6 BA x 1/4" or 2.5 mm x 5 mm screws.

Now comes a rather tedious job, namely, freeing up the hinges. Put plenty of oil on them and, holding them by the ends, work them back and forward as far as they will go. Keep this up until they're completely free and will just hang under gravity.

This is important because if it isn't done properly then the final scale will show stick-slip effects and will not return to zero all the time.

Finally, screw the three pairs of hinges to the bottom of the three cantilever beams and the centre piece to the ends of the hinges (see photo) using twelve more of the small machine screws. Last of all the whole board can be mounted on its nine spacers and it's ready to start testing.

Testing

Before you're able to test and calibrate the scale you'll need some accurate or accurately measured weights. If you have access to an accurate balance then you can weigh some convenient objects and use them. I used small food cans for the light weights but however you get them, you will need weights of about 180 grams, 1.8 kilos and, if possible, about four kilos. One possible answer is to go down to your friendly local butcher or greengrocer and ask to weigh them on his scales (if he gets all twitchy you know where not to shop in future!).

If you turn on the scales you will find that the zero adjust is hopelessly unstable and moves if you even wave your hand near it, but fear not, this is normal. It is because air currents over the strain gauges change their

temperature and hence their resistance. To fix this, wrap all three gauges completely in cotton wool at least 5 mm thick. The scale should then settle down after a few minutes and the zero will only change by 0.1 gram every minute.

With the electronics out of its case, even air currents over the bridge balance resistors will cause some drift but when everything is finally in its box these problems disappear. If you want, you can prepare the actual weighing pan before testing (I didn't bother).

I used a base from a plastic flower pot which was just the right size (and price!) and glued a nut, which fitted the threaded post, onto the centre of the bottom with Araldite (*lots* of Araldite). Don't use Araldite with brass nuts though — it doesn't like copper or copper alloys. Also, be sure that the nut has absolutely no grease or oil on it before glueing it.

Finally, the testing. Turn on the scale and give it a few minutes to warm up then adjust the zero set until it flickers between 000 and 001 (it can be -5 kg and still read 000). Then place the 180 gram weight on it and adjust RV3 until the scale reads correctly. The scale is now calibrated (there, wasn't that easy!) RV3 should be fairly close to the centre setting and if you can't get a correct reading at all, then there's a problem with the strain gauges or gain setting resistors R15, R16 and R17.

The scale is now 90% operational and all that remains to be done is to connect the range switch up and mount the whole thing. The range switch is a two (or more) pole, three-position rotary switch which selects R16, R17 or nothing to vary the gain of the second gain block between 100, 10 and 1 (actually 101, 10.1 and 1.01, but who cares!).

A second section of the switch is used to select the appropriate decimal points on the display. Use about 100 mm of ordinary insulated hookup lead to connect the gain switching resistors to one section of the switch. The common terminal of the switch is connected to pin 6 of IC3 and the 10k resistor R16 goes to the centre terminal of the switch to select the middle or 2 kg range. Resistor R17, the 10 ohm resistor, selects the high or 5 kg range and the terminal that selects the 200 gram range is left open circuit.

Also, wire up the decimal point resistors using lengths of hookup wire about 150 mm long. The common contact of this switch section goes to the +5 volt rail (there's a pad provided near the decimal point pads and resistors).

If you can't follow the wiring diagram, rather than laboriously explaining which pad selects which decimal point, the easiest way is for you to select each gain range in turn and try the terminals on the switch to get the right ones. For the 200 gram range the display should show '00.0', for 2 kg '000' and for 5 kg '0.00'. Connect the appropriate leads and things are almost ready to finally go in the box.

First, drill the two holes in the side of the box to accept the switch and zeroing pot then assemble the main board and mounting plate into the case with three self-tapping screws into the holes already drilled.

Tighten it down then carefully locate the power supply board on the inside of the rear of the case as far up as it will go without fouling the top of the case when it is put on. The power supply transformer must not interfere with the cotton wool insulation on the strain gauges at all. Mark the position of the four mounting holes and drill them with a 3.6 mm (9/64") drill. Attach four 6 mm (1/4") spacers to the four corners of the board and then screw in the power supply itself.

Next, cut an appropriate hole to the left of the power supply board and run in the mains lead you intend to use. To abide by the law you must have some way of clamping the flex so it can't be pulled out.

Use a 'clamp grommet'. Strip off about 40 mm of the outer cover from the flex you are going to use and feed it through the hole and clamp it. Then bare about 5 mm of the active and neutral leads and screw them into the cable clamp. Solder a lug onto the earth lead and screw it tightly under the centre screw, holding down the main board. That's the power connected. Then put in the zeroing pot and range switch with the zeroing pot towards the back (as far away as possible from the crud from the display).

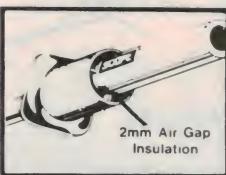
Now all that remains to be done is to cut out the holes in the top cover and attach it and you've just built yourself a set of scales. Measure off exactly where the display comes through the top cover and cut a hole about 62 mm x 19 mm (but measure it off the case carefully — don't guess it) to clear the display. You also need a hole about 20 mm in diameter to clear the weighing pan shaft. Attach the front panel label to the top cover or label it as you see fit and the mechanics are completed.

Before sealing things up it's time for final calibration. Power up the project and give it a minute or so to settle down then select the 200 gram range and adjust the zero exactly. The display should be flickering between '700.0' and '00.0'. Place the accurate 180 gram weight on the pan and ensure that the display reads correctly. Adjust RV3 if necessary to pull it right into line and it's finally calibrated. Change ranges and check with the heavier calibrated loads if you have them.

Remove the weighing pan, screw on the top panel and replace the pan and your electronic weighing scales are complete!

The scales will always take a minute or so to warm up and settle down as the two strain gauges must be equal in temperature to about 0.001°C, or at least steady in temperature. Also, the zero set will have to be used often as temperature variations do occur. Loads over 5 kg may cause the scale to hit bottom but this does not damage. It may be necessary to recalibrate the scales every few months if you really want accuracy. Happy weighing, people!

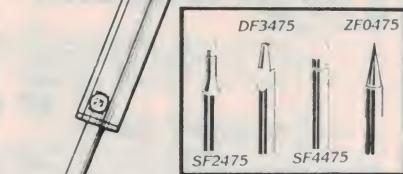
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This neatly bound book contains all commands supported by Microsoft BASIC interpreter for CP/M-80. Each command is dealt with individually and commented on such as Purpose, Syntax and examples. An excellent book.

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★ MICROBEE ENGINEERING NOTEBOOK

This notebook contains hardware modifications, improvements etc. Some of the modifications include printer interfaces, cassette motor control, 64K ROM pack, Joystick and lots more. Definitely value for money.

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★ WILDCARDS Vol. 1

A potpourri of application notes and tips for the MicroBee. This book has received rave reviews from all computer publications. A must for all MicroBee owners.

Cat. XB-9010 \$15.00

★ WILDCARDS Vol. 2

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It has been brought to our attention that one major advertiser is showing a picture of XIDEX floppies but actually selling a cheaper floppy in small quantities.

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The XIDEX disks are supplied in a magnificent snap-shut case when purchased in boxes of 10.

Cat. XC-4770 5 1/4" double sided double density soft sector 1-9 \$5.95 ea

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NEW - MOTORCYCLE INTERCOM

(Ref: EA March 1984) Now you can talk freely and safely to your pillion passenger with this handy kit!

Cat. KA-1533 **\$39.95**

NEW!! - DELUXE CAR BURGLAR ALARM

(Ref: EA May 1983) Great new design from EA. This one is very sophisticated. (Auxiliary battery extra) Complete kit of parts.

Cat. KA-1550 **\$69.50**

CONTACTLESS HALL-EFFECT "BREAKER POINTS"

SEE EA DECEMBER 1983

A professionally engineered electronic ("breakerless") contact breaker system.

Yes, only Jaycar has a complete Hall-Effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following:

• HALL EFFECT TRIGGERHEAD

• MAGNETIC ROTORS FOR BOTH 4 & 6 CYLINDER CARS

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• YOU CAN REMOVE THIS SYSTEM AND RE-EQUIP YOUR CAR WITH THE ORIGINAL BREAKER POINTS WHEN YOU SELL THE CAR!

• AS EASY TO INSTALL AS A SET OF POINTS

• INSTRUCTIONS (SIMPLE-TO-FOLLOW) INCLUDED

This set is designed to fit most European and Japanese cars. In fact it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco or Autolite electrics. If you wish to check first, please send SAE for car/distributor list.

Because we have no way of knowing, you get the fitting set for ALL of the distributors available. Basically you end up with a jar full of parts you don't need to use! (Perhaps for your next car?)

Quite frankly, we are amazed that we can supply such a comprehensive kit for this price. To produce a kit that will adapt to the dozens of different distributors around is amazing!

Remember, once you have installed a breakerless system it will never wear out and that part of your system will remain in tune FOREVER.

Cat. KJ-6655

PLEASE NOTE: This system must be used in conjunction with an electronic ignition. The Hall-Effect device will not switch enough current to replace the contact breaker points on their own!

\$29.95



TRANSISTOR ASSISTED IGNITION

REF: EA JANUARY 1983

Latest version of this fantastically popular kit! The Jaycar kit comes COMPLETE down to the plastic TO-3 transistor covers, genuine heatsink and DIECAST BOX - as used in the original EA unit.

Beware of flimsy kits that use sheetmetal boxes.

This kit is designed to be used with contact breaker points. If you want Hall-Effect breakerless option may we suggest the KA-1505 version of this kit shown elsewhere on the page.

Cat. KA-1506

\$35



TRANSISTOR ASSISTED IGNITION HALL-EFFECT "BREAKERLESS" VERSION

REF: EA DECEMBER 1983

This kit is virtually identical to the KA-1506 except that it contains the interface electronics for the KJ-6655 Hall-Effect triggerhead.

Cat. KA-1505

\$36.95



ETI340 CAR ALARM

Ref: ETI April 1984

\$69.50

A versatile security system that provides full protection for almost any vehicle. This unit will protect your valuable vehicle from virtually any sort of interference - from hubcap stealing to being towed away! It does not rely on voltage or current sensing to trip the alarm, but 'resonance' microphones. It can also protect 'perimeter accessories' like driving lights and racks. The project meets the major requirements of car alarms set down by the NRMA. We believe that this alarm is one of the most comprehensive that we have seen. Once again Jaycar has taken the no compromise approach.

The Jaycar kit includes two of the specified resonance microphones, original die-cast box etc. (we supply "chocolate block" multiway connectors as well).

The complete kit is only \$69.50 inc. sensors.

Extra sensors are available for \$10 each Cat. AM-4000

IONISER KITS

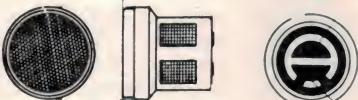
COMPLETE KIT

- High efficiency emitter head - Fits completely inside a high quality ABS box (NOT a metal lid) - Only 2-core mains flex protrudes from the box - You can pay over \$80 for a built-up inferior unit!
Cat. KJ-6511

SHORTFORM KIT

- runs directly from 240V mains
- low power consumption
- produces high intensity electric field
- output around 7.5kV
- will not necessarily produce ozone in standard form
- ideal for those who wish to 'try' an ioniser at an economical price.
Cat. KJ-6510

UNIDIRECTIONAL ELECTRET MIC INSERT



This is a brand new direct import unit that is ideal for the EA Parabolic Microphone project in November 1983 EA. Average sensitivity around 7dB BETTER than the common low cost electret insert.

The insert has a front-to-back ratio of 1.5:1. The power requirements are the same as for the low cost mic insert. Each insert is supplied with a comprehensive data sheet which includes connection details, specifications and frequency response graph.

Cat. AM-4012 \$3.95

JAYCAR JVE-1 VIDEO DETAIL ENHANCER

SPECIFICATIONS:

- Maximum enhancement not less than +8.3dB @ 2MHz
- Enhance disabled (Bypass) response, DC to 5MHz -0.5dB
- Colour subcarrier 0dB notch frequency, tunable to 4.43MHz. +/-0.5dB, all settings
- Amplifier group delay, less than 0.075uS.
- Signal handling capability not less than 1.35 volts p.p. (Sync. is clipped first)
- Power 12V AC @ 100mA
- Controls: ON/OFF, ENHANCE, ENHANCE/BYPASS SWITCH CORE/GAMMA CONTROL
- Input connector, RCA socket
- Output connector, RCA socket x 3

DESIGN FEATURES:

- A unity gain notch at the colour subcarrier frequency, whose purpose is to prevent chrominance to luminance errors at high enhance levels.
- A closed loop configuration with lead tag compensation to achieve stable, well defined gain.
- DC coupling, eliminating large capacitors in series with the video signal and achieving DC response for applications requiring it.
- Low output impedance prior to termination resistors, enabling up to three outputs to exist and be used or left unterminated.
- A level dependent closed loop response or Gamma control ('Core').
- Clip on negative going signals at -67 volts into 75 ohms to prevent sync. errors owing to overshoot.

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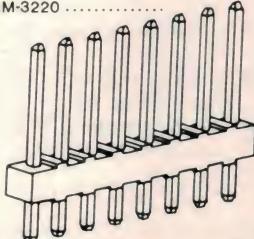
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Cat. ZZ-8450

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CROSSHATCH/DOT GENERATOR

REF: EA NOVEMBER 1983

For those TV servicemen, hobbyists, videophiles and those keen on computer graphics, a pattern generator is mandatory if the best picture is to be obtained from your screen. The kit is crystal locked and will produce blank raster, dots and a crosshatch pattern (in white).

The unit gives direct video out and RF modulated video out. The Jaycar kit comes complete with front panel, case and RF modulator.

Cat. KA-1530

\$28.95

Beware of inferior kits that do not contain all parts.

IDEA OF THE MONTH

Low cost appliance timer

Steve Garland

I originally designed this timer for controlling irrigation systems, particularly systems where frequent short duration applications are required. It proved very cheap, easy to make and reliable. Subsequently it has proven equally valuable for longer period timing applications, turning lights on and off each day, turning open field irrigation systems on and off twice a week and so on. In short, this timer will lend itself to any application where cheap reliable control is required.

The basis of the timer is Exars' 2240 programmable timer/counter. This is actually a 555 with its output wired to a binary counter. Eight outputs are available and they change state in the normal binary fashion on every pulse from the 555. The timing period of the 555 is set by an RC network on pin 13 of the XR 2240.

The counter is arranged in a 'wire-or' configuration through

the DIL switch. When the counter outputs match the switch outputs the output pin of the 2204, pin 10, goes high and counting is inhibited until the next trigger pulse.

The timer uses two of these counters, one to measure interval and the other duration. To initiate circuit action, SW3, the start button, is depressed. This puts a negative going pulse onto pin 11 if IC2. The rising edge of this triggers the IC. Pin 10 goes low and switches off Q2. This drives the collector up almost to the supply rail, turning on Q3, and thus the relay. It also acts as a positive going voltage on pin 11 of IC1, and so triggers it. The circuit operation of IC1 is now identical to IC2. The positive going voltage on pin 11 initiates the count sequence, pin 10 goes low, turning off Q1 and turning LED2 on. Incidentally this also puts a low voltage back onto pin 11 of IC2, thus effectively resetting its trigger circuits.

The result of this is that both counters are counting at the

same time. However, they are not counting at the same rate. IC2 (the duration timer) reaches its turn off count long before the interval timer (IC1). When this happens pin 10 of IC2 goes high and so turns the relay off.

The circuit will now wait for IC1 to finish counting. This defines the 'interval'. When it is finished pin 10 rises rapidly, becoming a rapid positive going voltage for pin 11 of IC2, and it thus has exactly the same effect as the original start pulse. The whole sequence repeats itself again.

The duration of the two timers is set by a combination of the timing period defined by the RC network on pin 13 and the setting of the DIL switches. $T = RC$ subject to the limitation that R should be between 1k and 1M and C between 7n and 1000 μ . Pin 1 will, in fact, change states at this rate, pin 2 at twice the duration and so on. With eight outputs it is possible to derive accurate timing intervals 255 times longer than RC . This

gives an approximate timing limit of about 70 hours.

Construction is quite straightforward, paying attention to polarity of diodes and capacitors. Make sure that the choice of filter capacitor is rated above the rectified voltage, i.e. >12 V for 240 V switching circuit and >32 V for 24 V switching circuit. The manual override switch must be a DPDT with adequate current capability and standard size (not mini) to enable sufficient separation between leads when soldered. Be sure to connect the output leads to the poles, with both mains leads at one throw and both relay leads at the other. This setup provides isolation between the two streams, but it is still necessary to pair the active and neutral leads on each pole to reduce the risk of short circuit and to comply with the standard wiring convention.

The choice of relay, manual override switch, fuse and wire gauge is decided by the output requirement. Usually 5 A at 240 V is adequate for your

IDEAS FOR EXPERIMENTERS

Range extension

Barry Bown of Lalor Victoria sent us this idea.

A problem with multimeters is that the 5, 10, and 50 volt range selection do not allow very accurate determination of voltages that lie just outside the range, like 12 volts.

He uses a 10 volt zener to convert the five volt range into a 10-15 volt range. In a similar way, almost any range can be obtained with the correct selection of zener values and meter range.

Meter Range	Zener Voltage	Extended Range
5 V	10 V	10-15 V
10 V	10 V	10-20 V
5 V	5 V	5-20 V
5 V	15 V	15-20 V



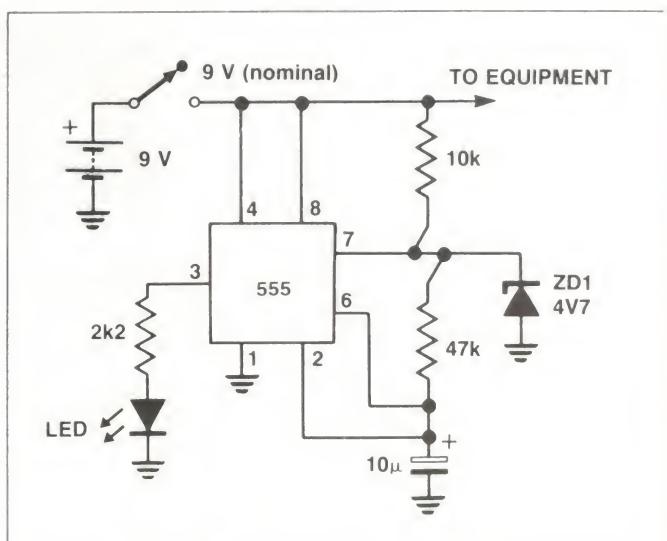
Low voltage alarm

J. Chubb of Kingsford NSW sent us his useful little circuit. It will light a LED when the supply voltage is above a certain level, and flash it when the batteries need replacing.

The values shown are for 9 V operation. Flashing starts at about 7V5 and the lamp won't light at all below 2 V.

The circuit consists of a 555 timer connected in the bistable mode and driving a LED. The trick is to connect a zener diode between pin 7 and ground. In normal operation pin 7 oscillates between one-third and two-thirds of the supply rail voltage V_{cc} . If $2/3 V_{cc}$ is greater than the zener voltage then the function of the 555 will be inhibited.

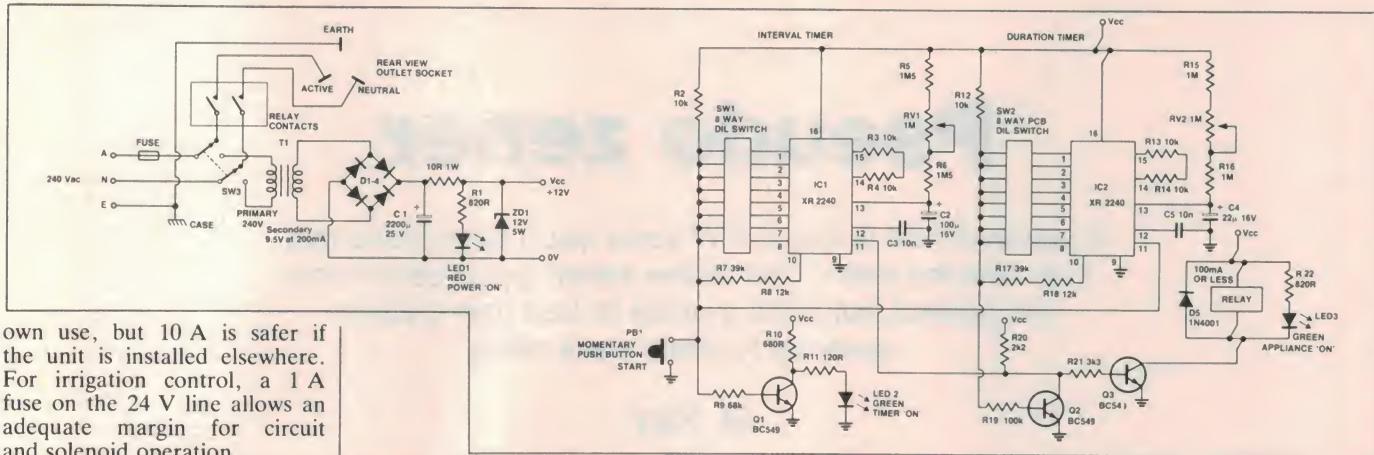
Thus to customise the circuit for your own requirements, decide on the minimum voltage that will operate the equipment correctly, and multiply by $2/3$. This is the zener voltage. R may



also need to be changed to suit the particular LED you use.

As originally constructed the indicator drew 7 mA at 9 V,

falling to 5 mA at 7 V. If these values are likely to cause problems try the CMOS version of the 555, the 7555.



own use, but 10 A is safer if the unit is installed elsewhere. For irrigation control, a 1 A fuse on the 24 V line allows an adequate margin for circuit and solenoid operation.

I generally use a 185x70x160 mm metal cabinet (such as sold by Dick Smith) for housing the unit as it provides a good amount of room inside for isolating the mains and transformer and can be directly earthed. For external applications, the timer can be housed in a rigid PVC junction box, with supply and output run through conduit, transformer and PCB fastened with nylon bolts and all holes sealed

with silicone.

Once construction is completed, confirm the 12 V supply. Then turn on switch 1 of each DIL switch, grab a stopwatch or watch with seconds clearly displayed and power on. The red LED only should be on. If one of the timers has accidentally fired (either green LED is on) turn the power off and on again. When ready, depress the 'start' button and start timing immediately that

you release it. Timing extends until the moment that the 'appliance on' LED cuts out. Adjust RV2 and repeat until the required duration is obtained.

Repeat the above for the interval period, adjusting via RV1 and timing from when you release the start button until the 'appliance on' LED lights for the second time. Having completed this, bundle up your timer and you are

ready to roll.

If the timer is being dedicated to one purpose with constant interval and duration periods, you can streamline the project (and the cost) by hard-wiring the timer output connections, deleting the manual override, mounting the fuse in a PCB holder and connecting the appliance leads directly to the relay, bringing the all-up cost of components down below \$30 for 240 V at 5 A.

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COUPON

Cut and send to: Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.

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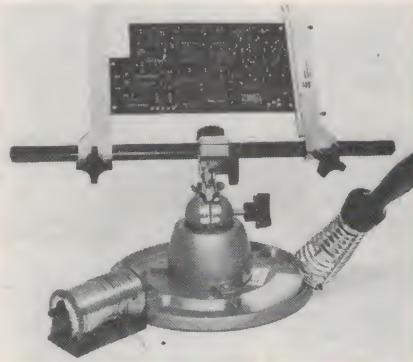
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RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of

the last day of the month.

The winning entry will be judged by the Editor of ETI Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

The winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI Magazine.

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly

written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid \$10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

Pseudo zener

If you ever had to buy a 5 W zener you'll have found that they cost the earth. This 'active zener' circuit uses three components but costs a whole lot less than a power zener up to many watts rating.

D. Kay

THE CIRCUIT CONSISTS of a transistor Q1 which dissipates most of the power and a zener diode ZD1 which supplies a reference voltage. When the voltage on the collector is greater than the total voltage across the zener and the transistor's base-emitter, Q1 will start to conduct, lowering the voltage on the collector. The circuit will reach a point of equilibrium where only enough current flows into the base of Q1 via ZD1 to maintain the collector-emitter voltage.

A zener diode is usually operated reverse biased i.e. positive applied to the cathode. However, when it is forward biased it will conduct with only less than one volt (approximately 0.65 V depending on the current) across it. To simulate this in the artificial zener a diode D1 can be used although in most applications this is not necessary.

Transistor Q1 still has to dissipate the power that would otherwise be dissipated in an expensive zener. There is no way of avoiding this dissipation and it should be remembered when heatsinking Q1.

Table 1 enables you to select the transistor type depending on the zener diode that you require. Information is given as to whether or not the transistor needs to be heatsinked. If Q1 does require heatsinking the maximum temperature of the mounting base is given; if Q1 does not need to be heatsinked then the maximum ambient operating temperature is stated.

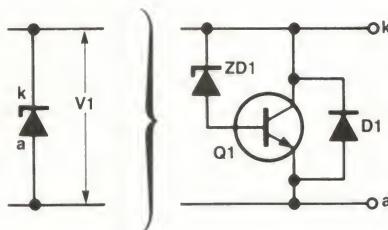
As an example, a pseudo zener of 33 V at 400 mA is required (33 V is part of the standard zener ranges). If you look down the 40 V column (the lowest voltage in the table above the voltage required) and across the 500 mA row (the lowest current above the 400 mA required) you will find that you need a 2N3055 transistor heatsinked and with a mounting base temperature that is less than 170°C. The zener diode that is used as a reference needs to have a voltage rating of 32.35 V.

$$ZD1 = V1 - 0.65 \text{ from table}$$

$$\therefore ZD1 = 33 - 0.65$$

$$\therefore ZD1 = 32.35 \text{ V}$$

The nearest zener diode easily available has a voltage rating of 33 V which gives a nominal V1 of 33.65 V and a maximum of 33.8 V.



$$V1 (\text{max.}) = ZD1 + 0.8 \text{ V from table}$$

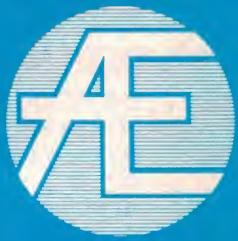
$$\therefore V1 (\text{max.}) = 33 \text{ V} + 0.8 \text{ V}$$

This excludes the tolerance of the zener diode and assumes the transistor is at 25°C. The temperature coefficient of the transistor is approximately $-2 \text{ mV}/\text{C}$.

The 33.8 V maximum voltage is a pessimistic rating and should be less; 0.8 V in 33 V is only one part in 42 anyway.

	8 V	16 V	40 V	
Transistor Heatsink Max. temp.	BD137 no 50°C ZD1 = V1 - 0.65 V1 < ZD1 + 0.80	BD137 no 50°C ZD1 = V1 - 0.65 V1 = ZD1 + 0.80	BD137 no 50°C ZD1 = V1 - 0.65 V1 = ZD1 + 0.80	25 mA
Transistor Heatsink Max. temp.	BD137 no 50°C ZD1 = V1 - 0.67 V1 < ZD1 + 0.84	BD137 no 50°C ZD1 = V1 - 0.67 V1 < ZD1 + 0.84	BD137 yes 110°C ZD1 = V1 - 0.67 V1 < ZD1 + 0.84	50 mA
Transistor Heatsink Max. temp.	BD137 no 50°C ZD1 = V1 - 0.77 V1 < ZD1 + 0.88	BD137 yes 110°C ZD1 = V1 - 0.77 V1 < ZD1 + 0.88	BD137 yes 110°C ZD1 = V1 - 0.77 V1 < ZD1 + 0.88	100 mA
Transistor Heatsink Max. temp.	BD137 yes 110°C ZD1 = V1 - 0.73 V1 < ZD1 + 0.90	BD137 yes 110°C ZD1 = V1 - 0.73 V1 < ZD1 + 0.90	2N3055 yes 188°C ZD1 = V1 - 0.65 V1 < ZD1 + 0.68 1 watt zener	200 mA
Transistor Heatsink Max. temp.	BD137 yes 110°C ZD1 = V1 - 0.81 V1 < ZD1 + 1.00	2N3055 yes 188°C ZD1 = V1 - 0.65 V1 < ZD1 + 0.80	2N3055 yes 170°C ZD1 = V1 - 0.65 V1 < ZD1 + 0.80 1 watt zener	500 mA
Transistor Heatsink Max. temp.	2N3055 yes 188°C ZD1 = V1 - 0.70 V1 < ZD1 + 1.00 1 watt zener	2N3055 yes 170°C ZD1 = V1 - 0.70 V1 < ZD1 + 1.00 1 watt zener		1 A
Transistor Heatsink Max. temp.	2N3055 yes 170°C ZD1 = V1 - 0.80 V1 < ZD1 + 1.30 1 watt zener			2 A

Table 1. Pseudo-zener cross-referenced with the required transistor. Unless stated the zeners are rated at 400 mW.



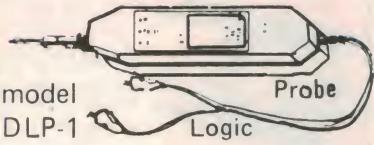
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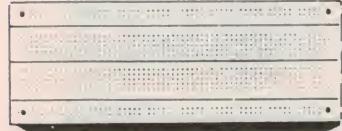
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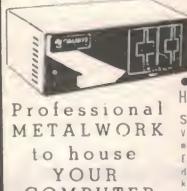
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1986 a 'banner year' for amateur satellites

Worldwide, 24 hour-a-day satellite communications by radio amateurs may be a reality before the end of the eighties, according to a report in the US-based *Westlink Report* late May.

The Amateur Satellite Corporation (AMSAT), announced in April that it was negotiating for a major new launch opportunity early in 1986. This was to have a payload capacity equal to or exceeding that of the highly successful OSCAR 10 satellite launched in 1983. OSCAR 10 currently provides across-the-globe contacts for radio amateurs employing its VHF and UHF transponders.

AMSAT's announcement said, in part, "... this opportunity could be used to orbit the Phase 3C satellite, which is planned along the same technical lines as the OSCAR 10.

"In fact, 1986 could be a banner year in amateur satellites with as many as six new satellites launched.

"Besides the Phase 3C OSCAR, the French ARSEN, Japanese JAS-1 and the digital 'store-and-forward' PACSAT may all be orbited during 1986."

The Russians are also tipped to join the flurry in 1986 with a

series of new Radio Sputnik packages.

Meanwhile, preliminary discussions have taken place in the US on the possibility of launching what is termed a "constellation" of geostationary amateur satellites to provide global coverage. These spacecraft would operate in either the 1.2 or 2.4 GHz bands, or a combination of the two, to be launched 1986-87. Potential user support is crucial as the geostationary option is a costly one and broad user support from the world's amateur community is necessary.

AMSAT is inviting comments on what benefits might result from such an undertaking and what level of financial support might be realistically envisioned. Based partially on responses, AMSAT will assess the viability of such a program. Comments should be addressed to AMSAT, P.O. Box 27, Washington DC 20044 USA.

UOSAT II lives!

Following an international effort by teams in the US and Britain during May, UOSAT II was commanded on-air on Monday 14 May.

The satellite, built by a team at the University of Surrey (UK), mysteriously stopped transmitting early in March and stubbornly denied efforts to bring it back to life.

During the second weekend in May, radio amateurs from Stanford University in California managed to pick up feeble signals at an outpost in Greenland.

The signals were from UOSAT's receivers and so weak that even the giant dish at Jodrell Bank in the UK had been unable to trace them.

The Surrey University team tried to regain control on the 144 MHz command frequency, but were unsuccessful. Upon trying 438 MHz just after midnight on Monday 14 May, the main beacon responded with a strong signal. Surrey reports the craft is in good order and in the right orbit.



Margaret Howard, presenter of BBC World Service's Letterbox programme.

BBC world service

The BBC World Service to Australia up to September 29 is now being carried on additional frequencies, extending daytime coverage for winter reception in the South Pacific area. The BBC World Service operates 24 hours a day and the schedule for Australian listeners is 0600-1515 and 2000-0015 UTC. There is a short transmission at 0300 on 153-80 kHz from the Singapore relay base, to give lunch time reception in the Sydney area. At 0600 the main transmissions are on 9640, 11955 and 15070 up to 0915. From 0900 a service is available on 11750, 15310 and 21550 kHz. Morning reception in Eastern Australia of the BBC World Service from 2000 UTC is available on 9410, 9570 and 15070 kHz. New Zealand listeners have additional transmissions from 0300 onwards on 9410, and later on 5975, while early morning broadcasts commence at 1600 with 15070 and 15310 kHz providing the first hour's broadcast. After 1800 5975, 9410 and 9655 are scheduled to New Zealand and the South Pacific.

Letters from listeners make

Arthur Cushen

Radio Japan expands service

The Japanese broadcaster, Radio Japan, recently began using its first overseas relay base when it leased eight hours a day broadcasting time from the African Number One transmitter at Moyabi in Gabon. These transmitters will carry Radio Japan's programme to Africa and the Middle East and are linked by satellite from Tokyo to Paris, and then carried over a further satellite to the transmitters at Moyabi. Radio Japan is issuing two special verification cards to commemorate the use of this relay station, one card shows the North Pole centred on the verification and traces a programme service by satellite to Paris and Gabon. The second verification shows a map of Africa and details about the relay station, Africa Number One.

Radio Japan's engineers are now looking at building two new relay bases — one in Thailand

and the other in Panama. The relay station in Thailand will be located near Bangkok, and will be used to beam programmes for reception in Asia. The site of the Panama relay station has yet to be determined and this shortwave broadcaster will be used also by the Panama authorities for a shortwave service when not carrying Radio Japan's transmissions to North, Central and South America.

Radio Japan's transmitter site at Yamata is to be upgraded as these facilities have been in use since 1952 when Radio Japan recommenced its shortwave service after its close down at the end of World War II.

Radio Japan's surveys indicate that with the use of higher powered equipment in Japan and the three overseas relay bases they will be able to serve a world wide audience, but their engineers feel that parts of the

USSR, Alaska and Canada may have marginal reception.

Radio Japan is operated by NHK (the Japanese Broadcasting Corporation), and in the 1930s used the slogan, Radio Tokyo, when verifying reception reports. Since the 1952 reopening of the station, broadcasts have been rapidly expanded to offer both regional services, and the General Overseas Service, which carries news in English and Japanese on the hour, every hour.

Radio Japan broadcasts in 21 languages and their session 'let's Learn Japanese' is available, not only in English, but in 20 of their language broadcasts.

The regional service to Australia and New Zealand is broadcast 0845-0945UTC on 11875 and 15235 kHz. The transmission highlights include 'Hullo Australasia' on Sunday and 'Radio Japan DX Corner' on Monday.

Arthur Cushe

Distress radio

Telmar Communications has released a distress alarm with a difference.

The product is designed to operate in an existing radio system as would an ordinary radio. To ensure excellent range, the UHF distress transmitter delivers over 300 mW. A unique code is usually imbedded in the carrier, to be detected by the company's normal base station, and thus raise an alarm.

Telmar has been successful in obtaining approval for this product as a portable radio and licencing is therefore quite straight forward. Naturally this transmitter then becomes a part of the usual radio system.

Information about this transmitter may be obtained, by writing to Telmar Communications, 604 City Road, South Melbourne Vic 3205. (03)690-8666.

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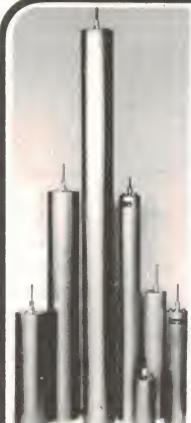
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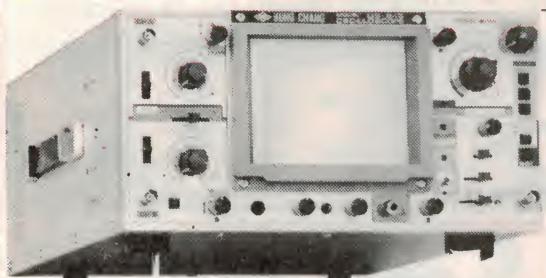
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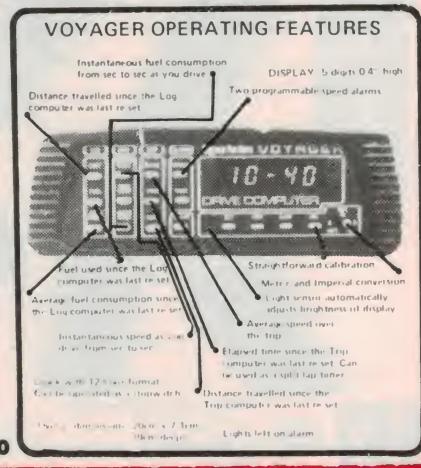
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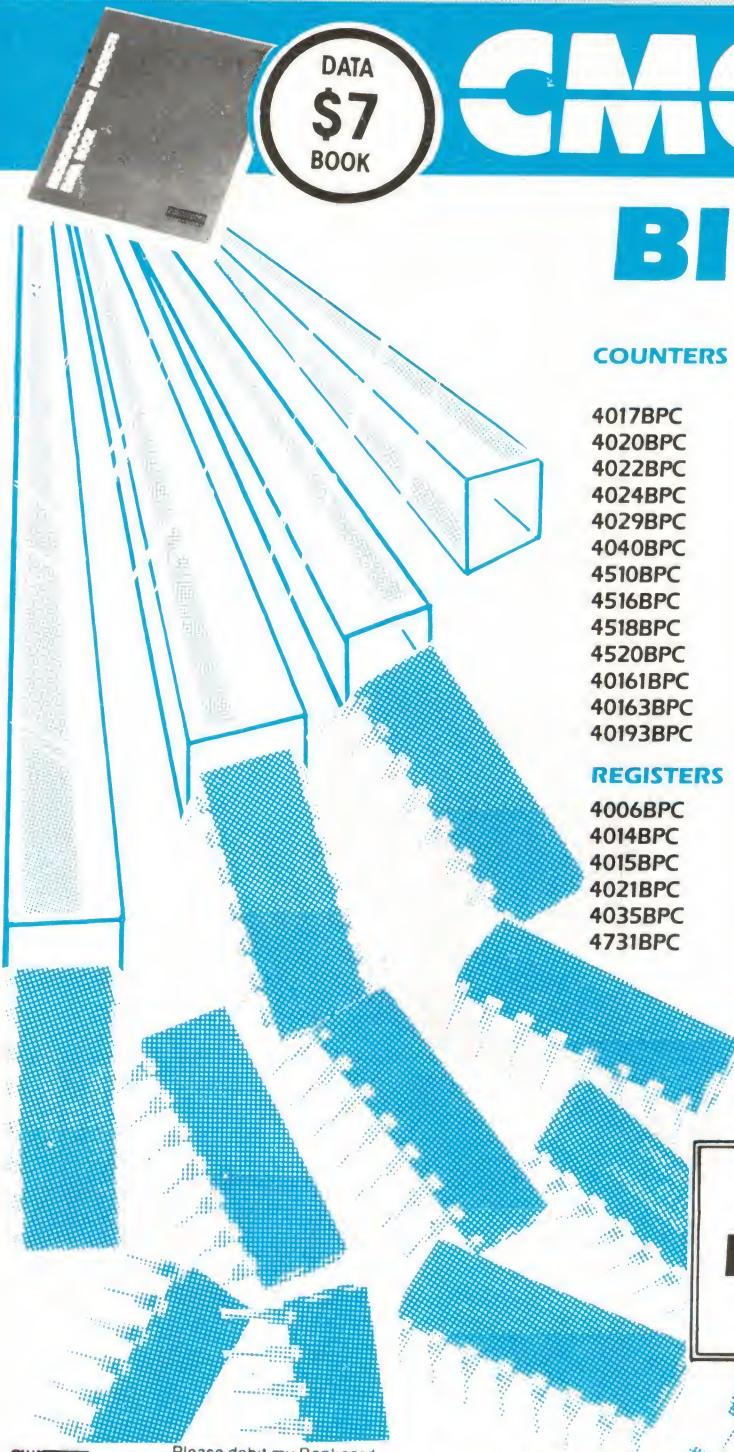
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4047BPC	.75	.54	.47
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40085BPC	.90	.85	.78

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	100	500	1,000
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4012BPC	.27	.23	.20

AND GATES

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4081BPC	.34	.27	.23

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4071BPC	.34	.27	.23

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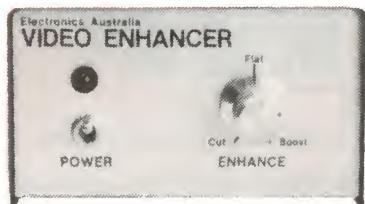
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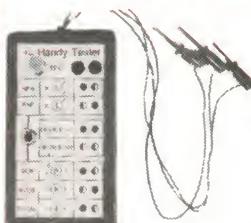
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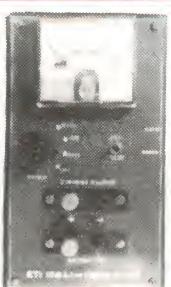
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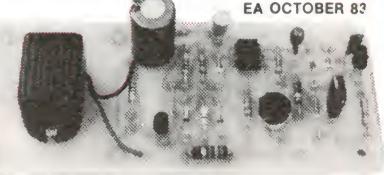


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A 25 watt booster amp for UHF mobile rigs

Ian Thomas

THE READY availability and good general performance of compact mobile amateur UHF FM transceivers has led to something of a 'boom' in activity on the 430 MHz band. Repeaters have begun to spring up in increasing numbers and general development of the band is paralleling that of the two metre (144-148 MHz) band in the early 70s. And that's all to the good.

There's just a *little* fly in the otherwise sweet-smelling ointment, though. Most rigs available off the shelf (and that's where most operators start these days) have relatively low power output. That's fine as the designers have to keep down the cost, size and heat output. While gain antennas are available for mobile operation, there's a limit to the size of antenna you can hang off your vehicle. For effective mobile operation, repeaters notwithstanding, you need a modicum of power output, if not as much as you can get! The solution is an add-on 'booster' amp.

With FM operation, a signal increase of 3-6 dB can mean the difference between 'scratchy' reception and virtually noise-free copy. Hence, it makes sense to boost your output by a minimum of, say, 4-5 dB. UHF RF power transistors which take a 10 W input generally have gains in the 4-6 dB region, which suits our purpose nicely. Problem is, the higher the gain, the more money you pay per watt of output power.

Some time ago, your beloved Editor (Roger Harrison, or VK2ZTB to the cognoscenti) indicated he was interested in doing a UHF booster amp project while we were engaged in a discussion about RF design. Cost was a major consideration, so a suitable RF power device had to be found as its cost would be a major part of the overall cost. As it happened, Geoff Wood (of Geoff Wood Electronics fame — see *Over the Counter*, February '84 ETI), had on-hand a large quantity of 25 Watt Motorola UHF transistors and was looking for a project to wrap around them. Great minds think alike, as they say! The devices themselves weren't your state-of-the-art mickey-mouse transistor, but then, the price tag wasn't in that league either (like \$10!). Just what the Editor ordered!

The idea of having a bash at RF power amp design appealed to me, so when I had time I gave the matter some thought. This project is the result.

Samples were duly obtained. They were branded SRF1078 which, with a little research, turned out to be another name for 2N6136s. The appropriate Motorola data book gave a wealth of information on their

When you're running a UHF mobile rig, you need all the power you can get — repeaters notwithstanding. Most rigs run about 10 W out. This project will boost that to around 25 W, giving your signal quite a 'lift'. It's easy to build and get going and won't break the bank.

parameters, so we were away!

After some fiddling with data books, Smith Charts and a heavy duty soldering iron, I came up with a working prototype that virtually performed spot-on first go.

It's a fairly conventional design as far as UHF amps are concerned. 'Stripline' matching sections are used on the input and output to match the transistor to the 50 ohm input and output standard. The base is de-grounded via a quarterwave stripline section and dc is shunt-fed to the collector via another quarterwave stripline. Trimmers are used on the input and output so that you can adjust the amp for best input and output match. I attached BNC sockets to the input and output, enabling the project to be adapted to a variety of applications.

The project can be used, for example, as a simple 'insertion amplifier' in a power amp chain — its simplest configuration. As a booster amp for an FM mobile, antenna changeover switching needs to be added. Some schemes are suggested later, showing simple amp in/out switching or Tx/Rx switching in conjunction with a low noise preamp. You can please yourself on this score.

Design considerations

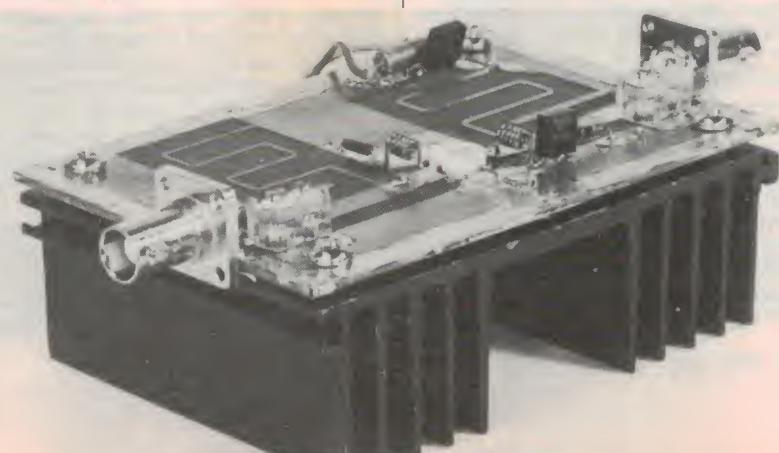
Since the transistors are moderate performance, low-price devices the rest of the design could not use any expensive or exotic components or materials. The SR1078/2N6136 has a guaranteed gain of 4 dB, which means that a transmitter with a

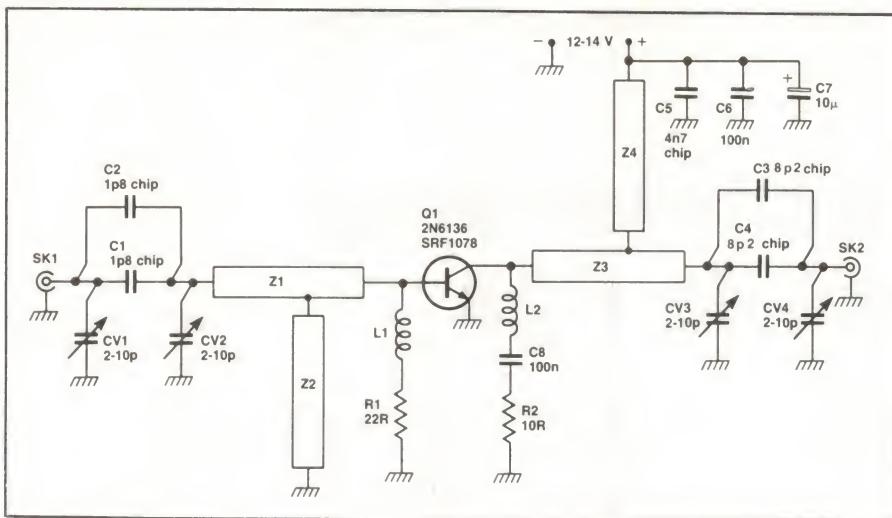
10 Watt output will very nicely drive the transistor to 25 watts output. Since the gain was so low great care had to be taken with the design to minimise losses or the thing would act more as a heater than an amplifier!

At 430 MHz any design must, of necessity, use some form of transmission line approach as one wavelength at 430 MHz is only 69.8 cm in free space. If connections in a circuit are longer than one or two *hundredths* of a wavelength then the effect of their length can no longer be ignored and must be allowed for in the design. Thus, capacitor leads, transistor leads and connections to coax sockets must either be nonexistent or taken into account in the design. For this reason, UHF transistors are housed in special packages and components like capacitors are produced having no leads at all!

The transistor comes in a stripline opposed emitter (SOE) package that is specifically intended to be used with microstrip. Since the design was to be cheap, the microstrip had to be fabricated from epoxy-glass laminate rather than the more expensive teflon-glass board (which is nigh on unobtainable because the local agents are only interested in big orders and apparently couldn't care less about providing a service).

Epoxy-glass was really never intended to be used in microstrip circuits and, as a result, its parameters are not controlled. This means both the board thickness and dielectric constant will vary considerably ►





from sample to sample (and probably across one sample too for that matter) so the design must allow for all possible spreads. With teflon-glass board, both the thickness and dielectric constant are controlled making design much easier.

Also with epoxy-glass board, material dielectric losses are starting to become apparent at 400 Hz-odd. So, the design couldn't contain too-long runs of transmission line that carry the full input and output power in order to minimise line losses. Accordingly, I kept the striplines to around

Designing power amplifiers at RF is mostly an exercise in designing matching networks to transform the 50 ohm input and output impedances into the very low input and output impedances of the transistor itself. In order to get all the input power into the transistor the input matching network must transform the amplifier input impedance (assumed to be 50 ohms) into the complex conjugate of the transistor input impedance given by the manufacturer to obtain maximum power transfer. Exactly the same considerations apply to the output network and in fact the two networks are very similar.

Motorola give the transistor impedances as large signal series equivalent impedances but they can sometimes be given in parallel resistances and capacitances. It doesn't matter how they're specified as they can be converted readily from one form to the other by simple algebra and are entirely equivalent.

Since the design of the matching networks must use, or at least allow for, finite transmission line lengths I chose to do the designs using Smith Chart techniques. The Smith Chart is a device invented by (would you believe) one Mr Smith. It is a graphical technique where all effects of components and transmission lines can be clearly and visually computed. It is an incredibly powerful and effective method and has the great advantage that the whole design can be seen at a glance on a graph rather than being lost in a jumble of mathematics.

I'm not going to go into the derivation of the Smith Chart here as there are plenty of excellent books available on the subject and, to be quite honest, I can't remember it all. I strongly recommend you get a book and read up on it a bit if you want to attempt any designs of your own — it's

worth it.

Before any design is attempted it's a good idea to get some idea of what is and isn't possible in terms of realisable components. At 430 MHz we're in an area where parasitic effects can dramatically alter the apparent value of a component. A good example of this is the effect of a piece of wire. If we consider a short length of wire above a ground plane as a lumped inductor then its inductance can be calculated from the formula.

$$L = \frac{\mu}{2\pi} \ln\left(\frac{4h}{d}\right) \text{ Henrys/metre}$$

This assumes that $h > 1.5d$. As the permeability of free space is $\mu_0 = 4\pi \times 10^{-7}$ we can tidy things up a bit and say

$$L = 0.0051 \ln\left(\frac{4h}{d}\right) \text{ microhenrys/inch}$$

where 'h' is the spacing of the wire above the ground plane and 'd' is the wire diameter.

That is, a piece of connecting wire $1/4$ " long and $1/4$ " above a groundplane has an inductance of about 5 nH or at 430 MHz, an impedance of 3.5 ohms! This means that at these frequencies a short circuit is an exceedingly difficult thing to build, about which I will say more later.

The effects of wire inductance don't end with crook short circuits though. If we have a 10 pF capacitor with about $1/4$ " lead length (not hard to have) then the capacitor will have an impedance of about $-j34$ ohms. But, the leads in series with it will have an impedance of $+j14.8$ leaving a total impedance of $-j19.2$ ohms for the capacitor plus its leads. This means the capacitor will not look like 10 pF but more like 17.7 pF because of the leads. Also, the length and spacing of the leads is almost impossible to control so our 10 pF capacitor will probably look like something between 15 and 30 pF.

For larger value capacitors (47 pF and greater) the capacitor may be series resonant with its leads and look like a short circuit (one way of building one) or even inductive.

Even this isn't the end of the bad news though. Because the capacitor and its leads are forming a partial resonant circuit there are circulating current flowing between the inductance and capacitance which increase

the losses in the combination so our 10 pF looks larger and much lossier. As losses don't help gain at all (apart from cooking the capacitor) using capacitors with leads seems to be not on.

This is the reason that the amplifier cannot possibly be built using conventional mounting methods and all UHF circuits are built with components mounted on the wiring side of the board. However, all is not lost and easy solutions are available.

If leads have intolerable effects the answer is to use capacitors that don't have leads. They're called *chip capacitors*, tiny ceramic blocks with solder on each end. A conventional dipped silver mica capacitor would be expected to have a parasitic inductance of about 5 to 10 nH, but chip capacitors have parasitic inductances of about 0.5 nH. Even better, they're readily available in Australia from IRH, who market the Murata range, and from Vitramon, who market their own. Both brands are pretty much the same and are very reasonably priced. Their only disadvantage is that they are so incredibly, fiddlingly *small* — $1\frac{1}{4} \times 1\frac{1}{4}$ mm! You really do have to have care and patience when soldering them in the circuit.

The next problem I had to sort out before commencing the actual design was what trimmer capacitors to use. That there had to be trimmers was a certainty. With the variability of the board material, some adjustment was bound to be necessary. All that I've said about lead inductances for fixed capacitors applies to trimmers as well, but with trimmers, at least the desired capacitance can be set if it's within the range of the capacitor. However, the killer here is the degradation of Q because of circulating currents.

When an amplifier is running at 25 watts out the trimmer doesn't have to get in the way of much of it to be melted to an amorphous blob. There are some truly impressive trimmers available (well not really available in Australia — see my earlier remarks on local agents). Gold-plated, machined from solid brass and works of art, but their price is pretty impressive too! To use them would mean the trimmers in the matching network would cost five times as much as everything else in the amplifier!

Philips however, make a range of very small trimmers that seemed to be OK if they were mounted with their leads bent out sideways and soldered directly onto the board rather than being soldered through the board as they were designed to. They are readily available and quite cheap so they had to be tried. In the final amplifier they probably are a major source of losses but they really are the only cheap alternative.

The last component problem to be cleared up is the form the inductors in the matching networks should take. I've been labouring the point that no matter what is done, if there is a piece of wire in the circuit then it will have a large inductance associated with it. The trick is to make this inductance controllable and predictable. 'U-shaped' pieces of wire could be used as inductors and quite a few amplifiers have been built using them. I liked the idea of using the lengths of transmission line needed to connect into and out of the tran-

sistor better so the inductors in the final amplifier are in fact simply tracks on the board with carefully calculated width and length.

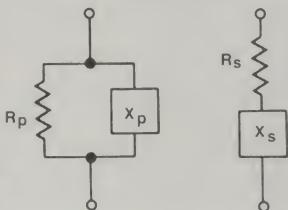
Designing the matching networks

The first point to be considered is the actual mechanical layout for the amplifier. The heatsink for the amplifier is about 110 x 75 mm so I decided to make the microstrip printed board the same size. Since the mounting area for the transistor on the heatsink is in the centre, this automatically placed the transistor in the centre of the board. In fact, for reasons that will be discussed later it was offset to one side slightly from the exact centre but it's still on the centre line of the long axis.

As the input and output connectors were intended to be placed at the two ends of the board, this meant that the tracks connecting the connectors to the transistor base and collector would have to be about 50 mm long. Since these tracks have to carry the full input and output power they should be as wide as possible to minimise ohmic copper losses. The base and collector leads from the transistor are 5.6 mm (0.22") wide so I decided to make the microstrip leads connecting to them the same width, thereby preserving a constant characteristic impedance along the line (ignoring the change in track metal thickness where the transistor leads are soldered). Taking the actual matching network configuration for granted for the moment, I had to allow about 10 to 12 mm at either end of the board. The space left gave two lengths of microstrip 40 mm long by 5.6 mm wide. These lengths form a major part of the matching networks.

The actual design of the networks starts

PARALLEL-TO-SERIES AND SERIES-TO-PARALLEL IMPEDANCE CONVERSION



Series to parallel equivalent

$$R_p = R_s \frac{X_s^2}{R_s + X_s^2}$$

$$X_p = \frac{R_p \cdot R_s}{X_s}$$

Parallel to series equivalent

$$R_s = \frac{R_p}{R_p + X_p^2}$$

$$X_s = \frac{R_s \cdot R_p}{X_p}$$

with the input and output impedances of the transistor itself. We start with the input matching network and, taking a Smith Chart (you can buy a pad of them from Aarque or some technical supply houses but if you do, try to get the ones with both admittance and impedance of the one chart — it makes things a hell of a lot easier).

The large signal input impedance is given as $1.3 - j4.11$ ohms at 470 MHz (for the sake of the exercise) so the first thing to do is mark this in on the Smith Chart. As the Smith Chart is in admittances the series impedances can be converted to admittances using the formulas given in the accompanying box. If you're lucky enough to have a chart with both admittances and impedances it can be plotted directly. The input admittance works out to be about $63 - j220$ mmhos.

The next thing to be worked out is the characteristic impedance of the 0.22" wide microstrip. To do this we use the somewhat daunting formula

$$Z_0 = \frac{377h}{\sqrt{\epsilon_r W [1 + 1.735 \epsilon_r^{-0.724} (\frac{W}{h})^{0.836}]}}$$

where

W = the width of the microstrip line

h = the dielectric thickness

ϵ_r = the dielectric constant of the board material

Also, a correction factor must be applied for W when the conductor has a finite thickness and is:

$$W_{\text{eff}} = W + \frac{t}{\pi} (1 \ln \frac{2h}{t} + 1)$$

where t is the thickness of the conductor. For normal one ounce copper it is 1.4 thou and the fibreglass is about 0.060" thick.

Cranking through all this we get $W_{\text{eff}} = 0.222$ so for very wide conductors the correction factor is negligible but for narrow lines it is not, as we will see when working out the bias stub lengths. Finally, we plug in the value for W_{eff} in the first formula and using a value of 4.5 for ϵ_r we get the Z_0 of the line to be 31.6 ohms. As I mentioned earlier, this value will vary a bit from board to board so there's not a great deal of point in working it out to 17 significant figures.

Once we know the Z_0 of the line we can, using the Smith Chart, work out the effect of the transmission line. As the Smith chart is normalised for 20 millimho (50 ohms) it is necessary to denormalise it to the 31.6 ohms of the transmission line. The centre of the Smith Chart corresponds to exactly 50 ohms so if we redefine this point to be 31.6 ohms then all other impedances must also be multiplied by 50/31.6 before they are plotted on the redefined chart. Thus the $1.3 + j4.11$ (input Z) on a 50 ohm chart becomes $2.06 + j6.5$ on a chart normalised to 31.6 ohms. This is marked in as point "B" on Chart A. Next we need to know the electrical length of the 40 mm of transmission line. This is worked out by first calculating the wavelength in free space from

$$\lambda_0 = \frac{c}{\text{freq}} = \frac{3 \times 10^8}{4.7 \times 10^8} = 0.638 \text{ metre}$$

where c is the velocity of light in free space

Next, the wavelength, assuming all the

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power in the microstrip is carried in the dielectric in the TEM mode (which it isn't) from the formula

$$\lambda_{\text{TEM}} = \frac{\lambda_0}{\sqrt{\epsilon_r}} = \frac{0.638}{2.12} = 300.8 \text{ mm}$$

or near enough to 300 mm

Finally, a correction factor must be worked out to allow for the increase in propagation velocity because some of the energy is carried in air and is

$$K = \left[\frac{\epsilon_r}{1 + 0.63(\epsilon_r - 1) \left(\frac{W}{h} \right)^{1.225}} \right]^{1/2}$$

evaluating with $\epsilon_r = 4.5$ we finally get $K = 1.120$, therefore the actual wavelength in the microstrip is

$$\lambda_{\text{real}} = \lambda_{\text{TEM}} \times K = 300 \times 1.120 = 336 \text{ mm}$$

Therefore, our 40 mm of line is equal to 40/336 or 0.1191 of a wavelength.

From point B on the Smith chart we must draw a constant VSWR circle in the direction towards the generator (the transistor base impedance represented by point B is the load) for 0.1191 of a wavelength to give point C on the chart. This point is still normalised to 31.6 ohms so to convert back to 50 ohms read off the impedance and multiply it by 31.6/50. Then replot the point on the chart, which is now back to a normal 50 ohms, to give point D.

I made the 31.6 ohm normalised impedance after rotation 5 + j60 ohms or 1.3 - j16.7 millimho. Therefore, after normalising back to 50 ohms the impedance is 3.16 + j37.9 ohms or, as admittance, 2.05 - j26.4 mmho. This is the actual admittance at the end of the input transmission line.

Next we consider the effects of the input trimmer capacitor CV2. As this capacitor is adjusted the impedance at its circuit node will follow a circle of constant conductance along the curve marked D-E'-E. When the amplifier is being tuned we can place E' anywhere we want on the circle within the constraint that the trimmer capacitor is a 2-10 pF device, so the minimum rotation is given by 2 pF and is 5.9 mmho (marked as E'). The maximum rotation is given by 10 pF and is 29.5 mmho (marked as E).

Next, we turn our attention to the input connector which is (hopefully!) exactly 50 ohms and is represented by the point in the exact centre of the chart. This is the impedance of the pin sticking out of the connector but there is a piece of copper ribbon connecting it to the board which has a series impedance that it would be prudent to allow for.

If we say the inductance of the connecting ribbon is somewhere between 0 and 10 nH, then there is a series Z of +j0 to +j30 ohms. This is plotted on the chart as curve F'F which is a constant reactance circle and we know the impedance on the board is somewhere in this arc.

Other aspects

As the transistor is operated in class C its base must be connected to ground for dc. All that is needed is a quarter wave line from the input microstrip to ground. As the input dc currents aren't all that large I chose to use microstrip line 1.3 mm wide. For bias stubs like this it isn't all that important what the characteristic impedance is as it's a short circuit at one end and an open circuit at the

other (if we get the length right).

First we work out the effective width of the line using the formula given earlier to get

$$W_{\text{eff}} = 0.050 + \frac{0.0014}{\pi} \left(\ln \frac{12}{0.0014} + 1 \right) = 0.0524"$$

The correction factor for the increase in propagation velocity must also be worked out again and is

$$K = \left[\frac{4.5}{1 + 0.63(4.5 - 1) \left(\frac{0.0524}{0.06} \right)^{0.1225}} \right]^{1/2} = 1.192$$

so finally, we get a wavelength for 1.3 mm wide track as 300×1.192 or 358.5 mm. Therefore, the quarter wave bias stub is 89.6 mm long.

This is too long to be included as a straight run so it's folded into a meander line. The golden rule here is to make sure that the meanders are at least three dielectric thicknesses apart to avoid interaction and to mitre the corners to avoid reflections at the bends.

The same process is repeated for the collector dc feed stub, except that I chose a 1.8 mm track here because the earth end has to be ac earth but the positive rail for dc. The chip capacitors I had for bypassing were 0.1" long by 0.070" (2.5 x 1.8 mm) wide so the chip capacitor that ac-earthed the end of the stub was the same width as the stub and (more or less) preserved its characteristic impedance to ground.

Repeating the calculation for K, we get $K = 1.176$ and hence one wavelength = 353.6 mm or a quarter wavelength of 88.4 mm.

This completes the electrical design and all that remains to be done is to lay out the board following the calculated dimensions. The tuning microstrips were continued almost to the ends of the board and gaps cut in them 1.3 mm (0.050") wide where the four tuning chip capacitors were to go.

As much of the board was left covered with 'earth plane', as it can't be emphasised too much how important a good solid earth is for the transistor. The SOE transistor package has two emitter leads on opposite sides of the device and both must be soldered massively to huge solid areas of ground plane. You can see on the layout that the ground is taken all along one side of the board to earth the emitter to the trimmer capacitors of the matching networks and on the other side a 20 mm wide strip of ground ties the transistor to the earth for the base and collector stubs.

Some final remarks on the design of the layout before going on to the construction: The transistor is operating in class C and as such generates quite a bit of power at higher harmonics. Since the output is asymmetric it is to be expected that a fair bit of this power would be at the second harmonic. However, not coincidentally, the dc feed stubs are a high impedance for the fundamental but at the second harmonic are half wavelength long and look like a short circuit again. This means that they act to suppress the generation of second harmonic power and this was one of the major reasons for their choice. The second thing that should be mentioned is that all the rather awesome formulae that have been invoked only deal with the effects that we want and I've tacitly ignored all sorts of bad things that can happen (and

do!).

All the practical notes on this type of amplifier mention that they're prone to oscillation at 20-80 MHz and this little beast proved no exception. To suppress these oscillations it's necessary to add on networks in both the collector and base circuits that're high impedance at 70 cm but are lossy as the lower frequencies. This is another good reason to keep the impedances low around the transistor ports — we can add on oscillation suppression components without worrying too much about changing the matching conditions.

I found it necessary to put damping on both the collector and base (although either is enough, both seemed a good idea) and, fortunately, only a few turns of air-spaced inductor give a nice high Z at the operating frequency. However, if you find that your amplifier draws a couple of amps for no drive power you have joined those who've been blessed with a 30 MHz oscillator instead of a 440 MHz amplifier! But more of this in the construction section.

Next, we consider how the input trimmer CV1 will modify the impedance arc F-F'. Once again, the trimmer is a 2-10 pF capacitor so the parallel admittance is 5.9 to 29.5 mmho. If the series inductance is zero, (unlikely) then varying CV1 will trace out a constant conductance arc H-G. If it is the maximum 10 nH, varying CV1 will trace out an arc H'-G'. This defines an area on the chart H-G-G'-H, which is the impedance on the board under the input connector that we want to transform to the impedance E'-E at the end of the input microstrip.

to do this, we add in the series capacitors C1 and C2. Two capacitors in parallel are used to try and distribute the current and lower losses, although it may not be necessary. The two capacitors are each 1.8 pF so we have a total capacitance of 3.6 pF, or an impedance of 94 ohms.

Adding in series capacitors causes the impedance from E'-E to be rotated along arcs of constant reactance to I'-I. Thus, if CV1 is adjusted to the correct value then C1 and C2 will transform the impedance at the end of the 31.6 ohm microstrip to the impedance under the input connector and the transistor base impedance will be transformed to the desired 50 ohms.

The complete, correctly adjusted transformation process is: The microstrip rotates the transistor base impedance from point A to D, CV1 rotates the impedance from D to E', C1 and C2 rotates it to I', where correctly adjusting CV1 changes it to F'. Finally, the parasitic input inductance transforms the impedance to F, the 50 ohm input impedance.

When designing matching networks like this there are really almost infinite possible combinations of network configurations that can be chosen. I chose this one for three main reasons. The first was that I didn't want to have components close to the transistor as, on the microstrip, impedances are low and currents are high. This means that voltages are low and as the dielectric loss of the epoxy glass board can be represented as a parallel resistance to ground from the microstrip, preserving low impedance minimises this loss. Also, adding in

Values shown on both charts are 'normalised' to 1.0 at the chart centre. For plotting the input impedance, chart centre represents 50 ohms. For calculations involving the input and output striplines (Z1 and Z3 on the circuit), the chart centre has been 're-normalised' to 31.6 ohms. All values should be multiplied accordingly.

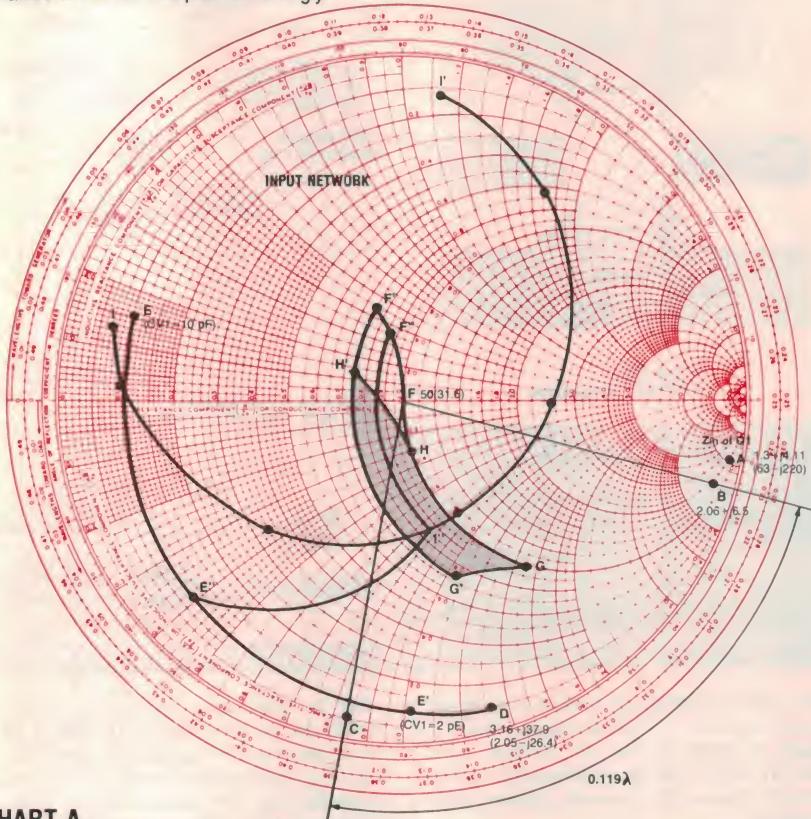


CHART A

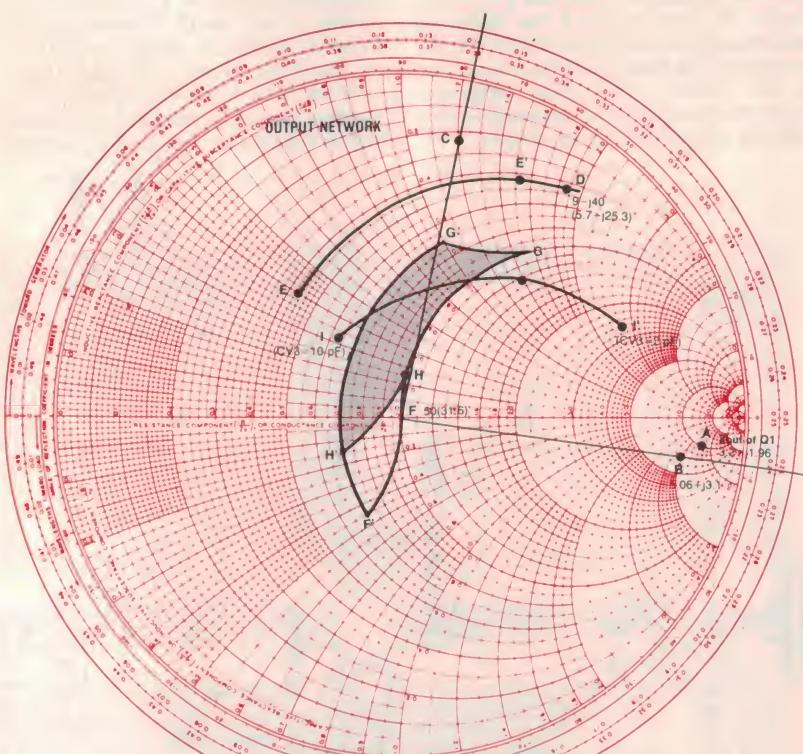


CHART B

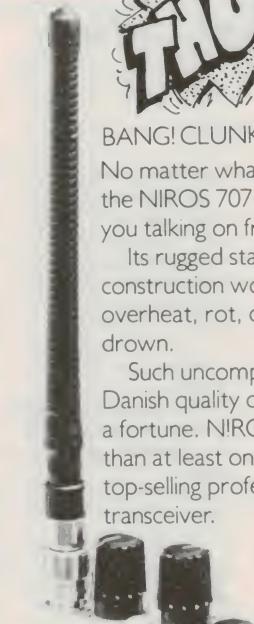


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capacitors near the transistor base would make grounding problems that much harder.

The second reason for the chosen network was that I wanted all trimmer capacitors to have one end at earth potential so they could be adjusted without the adjustment tool changing things. A very common matching network is to have C1-C2 a trimmer and delete CV1. It would work just fine

PARTS LIST — ETI-738

Resistors	all 1/2W, 5%
R1	22R
R2	10R
Capacitors	
C1, C2	1p8 ceramic monolithic chip capacitors, Murata type GR39 or Vitramon type VJ0805A1R8D.
C3, C4	8p2 ceramic monolithic chip capacitors, Murata type GR39 or Vitramon type VJ0805A8R2D.
C5	4n7 ceramic monolithic chip capacitor, Murata or Vitramon.
C6, C8	100n radial lead monolithic or disc ceramic capacitor.
C7	10μ/20 V tant., radial leads.
CV1,2,3,4	1p8-10p Philips film trimmers, type 2222-809-05002.
Semiconductors	
Q1	Motorola SRF1078 (2N6136)
Miscellaneous	
L1, L2	4½ turns self-supporting, 0.020" diameter enamelled copper wire wound 0.1" (2.5 mm) inside diameter.

ETI-738 pc board (double-sided); suitable heatsink (e.g. D.S.E. no. H-3460 or H-3422); BNC chassis mount sockets — two off; four 4BA bolts and eight nuts; coaxial changeover relay(s) as required; chassis to suit (if required), etc.

Price estimate: \$28-\$35
(less chassis and relays)

but then both sides of the trimmer would be 'hot' and tuning it up would be a pain.

The third reason for preserving a low impedance in the microstrip is that it makes the design of bias networks for the transistor that much easier. As the transistor must have correct dc conditions applied to it as well as the correct matching conditions, we have to be able to make dc connections to the base and collector that don't disturb the RF conditions. If we are connecting to a low impedance point then a merely moderate parallel bias impedance at RF is OK. If the microstrip were a moderate impedance then we would have to expend some effort to make bias circuits that were very high impedance or allow for the bias impedance in the design. But more about bias later.

The design of the collector matching network follows exactly the same procedure as the input except that the source and load are reversed so all the arcs on the Smith Chart go in the opposite direction. The collector impedance is $3.2 + j1.96$ ohms which, after normalising to 31.6 ohms goes to $5.06 + j3.1$ ohms. Rotating this impedance by 0.1191 (the length of the 40 mm output stripline) gives an impedance of $9 - j40$

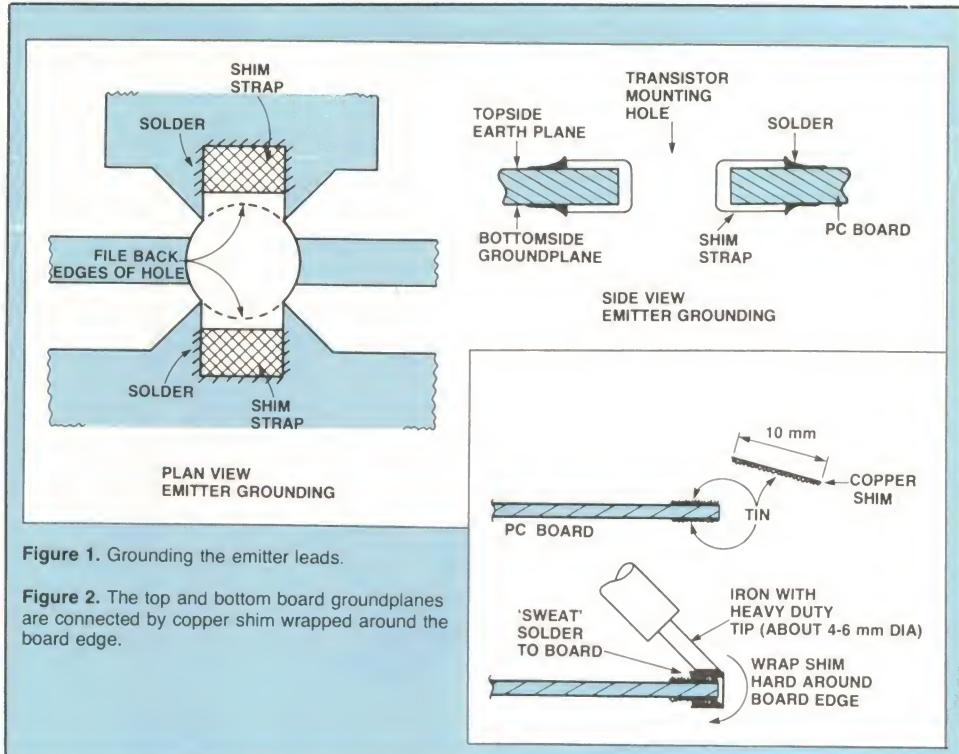


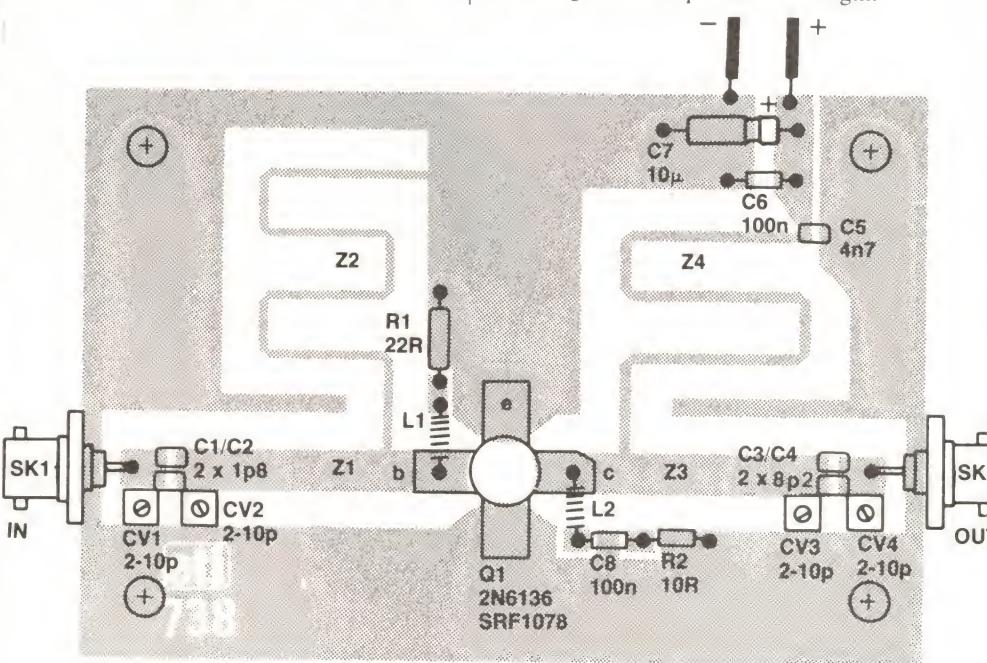
Figure 1. Grounding the emitter leads.

Figure 2. The top and bottom board groundplanes are connected by copper shim wrapped around the board edge.

ohms. After normalising back to 50 ohms, this goes to $5.7 - j25.3$ ohms which is marked as point D on the output chart (Chart B). Note that the rotation due to the microstrip goes in the opposite direction for the output.

Next, the 2-10 pF trimmer CV3 generates an impedance arc along circles of constant reactance to the arc I-I', which intersects the area mapped out from the output impedance transformed by CV4 and the stray series inductance of the connection onto the board. The only difference between the two matching networks is that C3 and C4 are 8.2 pF for the output.

Given that the matching networks seemed to be OK, the next matter to be sorted out was the input and output dc circuits. As wavelengths at these frequencies are quite short, the easiest way to generate a dc connection with a very high ac impedance is to use a quarter wave transmission line with one end connected to the circuit and the other end at ac ground. This corresponds on the Smith Chart to describing a complete half circle from the $Z=0$ point to the $Z=\infty$ point. The only things that limit the impedance are losses in the transmission line and tolerances preventing the line being an exact quarter wavelength.



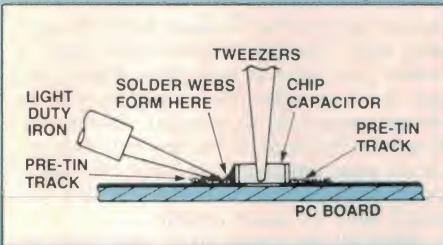


Figure 3. How to solder the chip capacitors in place.

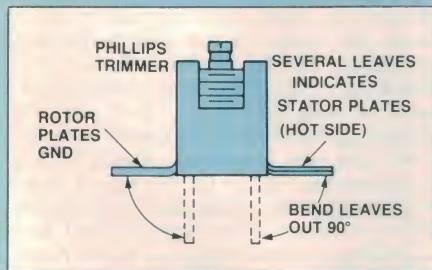


Figure 4. Bending the trimmer leads

Construction

The first thing to make is the printed board. The dimensions of all the critical tracks are given as components so if you want, you can tape up your own artwork. Try to stick as close as possible to the dimensions given or use the artwork provided but make the board two or three mm longer than the heatsink you intend to use so you can mount the input and output connections. The other side to the board *must absolutely* be solid, uninterrupted copper. Apart from being a good ground it is an essential part of the microstrip transmission lines! Make sure the two rectangular pads for the hot ends of CV1 and CV4 are big enough for the trimmers to be mounted without fouling CV2 and CV3 but no bigger. Also make sure that the two gaps that're bridged by C1/C2, and C3/C4 are exactly 1.3 mm wide so the chip capacitors can be mounted correctly. The same applies to the collector bypass capacitor C5, but the spacing of the other two collector bypasses, C6 and C7, is less important. Alternatively you could buy a ready-made board.

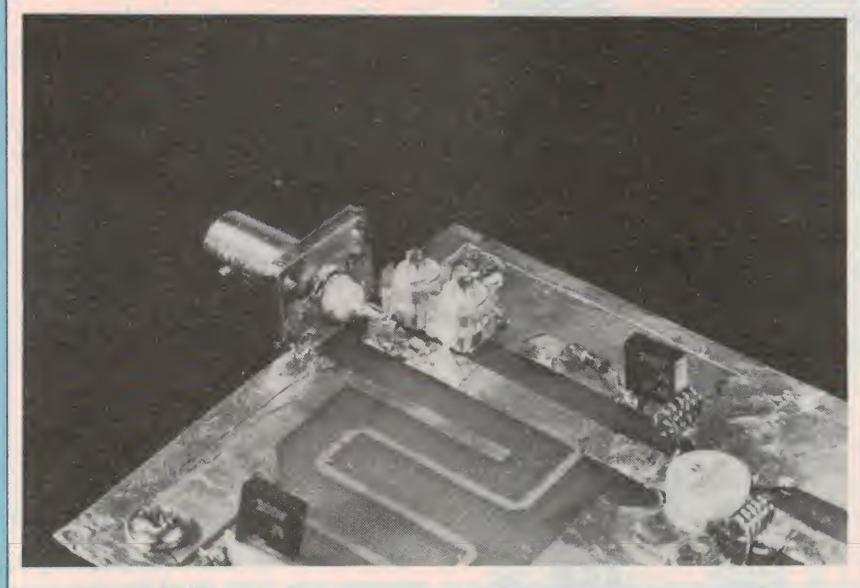
Once the board is etched trim it off neatly to the corner marks and drill a small hole where the transistor goes. Then, carefully locate it where it is to be finally mounted on the heatsink and clamp it firmly with a couple of G clamps. Next, drill the four mounting holes using a 2.4 mm drill right through the board and the heatsink making absolutely sure that you miss the heatsink fins and go into the spaces between them. The holes should be about 5 mm from the sides of the board and about 12 mm from the ends, but this will depend on the heatsink you use. Remove the board from the heatsink and open out the mounting holes to 3.6 mm. Next, open out the hole in the pc board for the transistor to a neat 10 mm. If you have a drill to do this, so much the bet-

ter but probably you'll have to use a rat-tail file. However, if you do it make sure it is centred correctly. Next, carefully cut out the two sides of the transistor mounting hole where the emitter leads are soldered according to the sketch in Figure 1 so the emitter leads can be earthed to the back of the board solidly. Cut two bits of copper foil about 5 mm wide by 10 mm long so they neatly fit into the two flats you've just cut for the emitter grounds. Form them tightly around the edge of the hole and solder them into position using lots of solder to be sure they're completely connected, but not so much that there's excess solder all over the board. This part is quite important as it connects the emitters to both the upper and lower groundplanes.

Next, attach the input and output connectors to the board. I didn't want to get involved with fancy mounting brackets so I simply soldered the connectors directly to the edge of the board using lots of solder.

The usual electronics soldering iron really isn't hot enough to do this so I clamped the connector in a vise with the flange side where the board is to be attached on top. After pre-tinning the connector, I held the board against it in the spot where it was to be mounted and applied a fine gas flame to the flange of the connector. This should be done with excruciating care as you only have to touch the flame to the board or the connector dielectric to, at best, make a hell of a mess and, at worst, ruin things completely.

When things are hot enough, pour in heaps of solder to make two good solid webs on both the ground-plane and wiring sides of the board then hold the board *exactly* vertical until the solder sets. The connector output pin should be over the edge of the pad on the board so it doesn't foul the trimmer capacitors.



Output line. View of the amp's output stripline section, showing the link to the BNC socket, the two trimmers and chip caps. Note the collector dc feed stripline.

I used BNC connectors as any minor mismatch they may cause can be tuned out with the matching networks. But unfortunately, BNC connectors are normally used with RG58C/U coax which is becoming lossy at these frequencies. If you intend to use longish runs of coax into and out of the amplifier you may choose to use type N or some other connectors which suit less lossy cable. Whatever you use, I think the direct soldering method has a lot to recommend it, as you get about the best possible electrical connection to the grounds on both sides of the board.

In order to complete the earthing on the board, cut long strips of copper foil about 10 mm wide and neatly tin one side all over. Next, work your way all around the edges of the board, tinning and groundplane and wiring side grounds in to about 5 mm from the edge. Next, cut the strip of copper foil so it's the same length as the board and hold the soldered side so it overlaps the edge of the board about 4 mm. Apply a soldering iron to sweat the foil onto the board (See Figure 2). If you line things up right you should be able to simply slowly run the iron along the foil to solder it to the board. Next wrap the foil *hard* around the edge of the board and repeat the process on the other side. The foil then solidly connects the groundplane side to the earth on the wiring side and gives the best earth I could come up with.

Repeat this process all round the edges of the board leaving a gap for the power supply where it comes to the edge of the board and taking the foil right up to the sides of the connectors. When you've finished, the only edge of the board that should be visible is about 10 mm where the +12 volts comes out. Once everything seems to be stuck down nicely it's a good idea to run around all the joints with a bit more solder to make ▶

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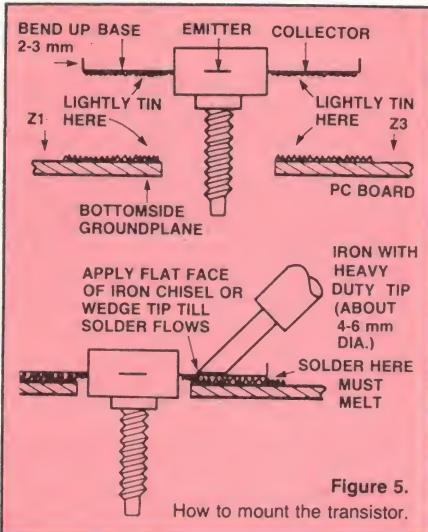


Figure 5.

How to mount the transistor.

sure; there's no such thing as too good an earth!

Now comes the fiddly bit; mounting the chip capacitors. First, tin all the areas where any components are to be attached but don't leave great waves of solder — it isn't necessary and can do harm. Then, using a fine pair of tweezers, pick up the chip capacitor to be mounted and hold it firmly in place over the gap in the track on the board. The two tinned ends of the capacitor should neatly overlap the tracks and it should be held hard down against the board.

Touch a soldering iron tip firmly against the track right next to the end of the capacitor to be soldered *but don't try to touch the end of the actual capacitor* (See Figure 3). The idea is to melt the solder tinning and carry the heat to the capacitor that way. As the track gets hot enough a neat little web of solder should form around the tinned end of the capacitor. Immediately remove the heat and allow things to cool. Solder the other end by just touching the iron next to the end but *don't* press down on the body of the capacitor or you may damage it.

With chip capacitors too much heat for too long *must* be avoided as you can cause the solder tinning to leach off the end com-

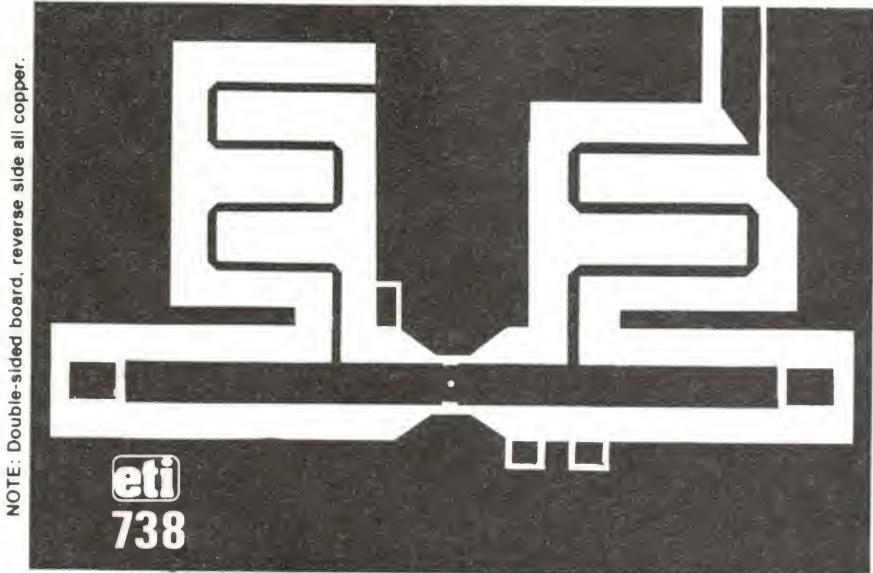
pletely. When you're working with these devices it's essential that you only take out the one device that you want to use because *they aren't labelled*. If you forget which is which you might as well throw them away and go buy some more because they're almost impossible to measure without putting them in circuit. Once they're in they are damn near impossible to take out again! After all these dire warnings I'm sure you won't have too much trouble.

After all the tuning fixed capacitors are attached, do the 4.7 nF collector bypass capacitor the same way and that's the fiddling finished.

Next attached the four trimmers by bending their leads hard out from the body (Figure 4) and mounting them as seen in the photo. Use plenty of solder but try not to allow the solder to run over to the chip capacitors. The lead that has three or four fine leaves is the stator of the capacitor and *must* be connected to the 'hot' side. The thicker gold plated lead is connected to the rotor and goes to ground. Attach all four trimmers then add on the two power supply bypasses and the preliminary board assembly is complete. Capacitor C6 must be a monolithic ceramic type as I inadvertently used a tantalum in the first model (once) and the RF currents blew it to pieces. Dramatic!

Next, the board has to be mounted on the heatsink. I tapped the four mounting holes with a 4 mm tap for the mounting screws. If you have one, this is a nice way to do it but self-tappers could be used as the screws carry no heat or power. Screw down the board component side up with spacers exactly 2.5 mm wide between the board and the heatsink. This space is absolutely critical as if the spacers are too high you will neatly pop off the top of the transistor when you bolt it in and if they're too thin you can't get smooth connections between the transistor and the microstrip. I actually rummaged around in my junk screw box and found four nuts the right thickness and drilled the threads out of the centre. You could use several washers instead, but however you do it, it must be right.

Screw down the board then drill the hole



for the transistor if you didn't do it when you drilled the mounting holes. The transistor mounting hole must be exactly in the centre of the hole in the board and have no burrs that interfere with heat conduction. Drop the transistor into its hole and make sure all the leads align nicely with the earth and microstrip. Bend up the end of each lead about 2 mm. If all is well remove it. Lightly tin the underside of each lead and smear the mounting base with heatsink compound. Pre-tin the striplines. Bolt the transistor in position with the base and collector leads exactly aligned (the collector is the lead with one corner clipped off at 45°). *Don't overtighten it* as the stud is only copper and painfully easy to strip.

With the transistor screwed down, the four leads should lie dead flat against the board; if the soldered copper foil for the emitter earths causes the emitter leads to stand proud remove the transistor and remove excess solder from the emitter earth thing and try again. When all is perfect, carefully flow solder all around and under all four leads. (See Figure 5).

All that remains to be done now is to make and connect the two oscillation suppression networks and the amplifier is finished. To wind the inductors I used a #42 drill shank as a mandrel (a complete set of number drills is an invaluable asset when winding inductors at these frequencies). Anything hard and round with a diameter of about 2-2.5 mm will do fine. The collector inductor has about 3½ turns of 0.5 mm wire but almost any wire will do so long as it's strong enough to be self supporting.

Bend the ends of the coil so one end sits nicely right in the middle of the collector lead and the other sits on the pad cut in the groundplane and solder it in. Next, bend the leads of the 100 nF bypass capacitor out hard against the body and cut them off about 2 mm long. Solder the capacitor in and bend the leads of a 120 ohm resistor with a slight kink in them so when they are soldered onto the board the resistor body is about 1 mm from the board, and solder in the resistor.

The same process is repeated with the inductor and resistor for the base but the base has no capacitor as both ends are at the same dc potential. The base inductor is the same in all respects as the collector but the base resistor is 22 ohms. When all this is done you're ready to power the thing up and make it work!

Tuning and adjusting

This process is always fraught with tension and drama as if you slip up it isn't too hard to wipe out the whole thing so be careful where you poke your screwdriver! Adjust all trimmers to about the mid-position, connect up your output load and signal source (turned off!) and finally the power supply set to about 12 volts. If at all possible, adjust the signal source to a lower power setting than the full 10 watts and arrange for the supply current to be monitored. Turn on the dc power then apply input power for just a few seconds then turn it off again. The amplifier should draw one or two amps when the input power is on but none when it is off. If it continues to draw dc power when the input is shut down then congratulations,

you've built an oscillator! If all is well, apply power again and adjust CV3 and CV4 for maximum power into the load.

At this stage it is assumed that some power is getting into the transistor but if no power comes out at all it may be necessary to adjust CV1 and CV2 until there is some output. I found that CV2 was by far the most sensitive and adjusting this should get results. Finally, adjust up CV1 and CV2 for maximum power then re-adjust CV3 and CV4. Go to maximum input power and repeat the whole process and you should then be getting a full 25 watts out of the booster.

Some helpful hints are as follows if the amp oscillates: L1 may be reduced to 2½ turns and this will stop almost anything but you will lose 0.2 or 0.3 dB of gain as the 22 ohms robs the base of input power. Likewise, L2 may also be reduced but here the problem tends to be that the 10 ohm resistor burns. You may have to use a larger resistor. I haven't included a ferrite bead in the power supply lines as it didn't seem to be necessary, but if you're having trouble, give it a shot. Lastly, if the 10 ohms in the collector tends to disappear in a cloud of smoke, but everything else seems to go OK, then you almost certainly have oscillation trouble. The only way enough power can get through L2 to do the deed is for there to be a lot of power at the lower frequencies.

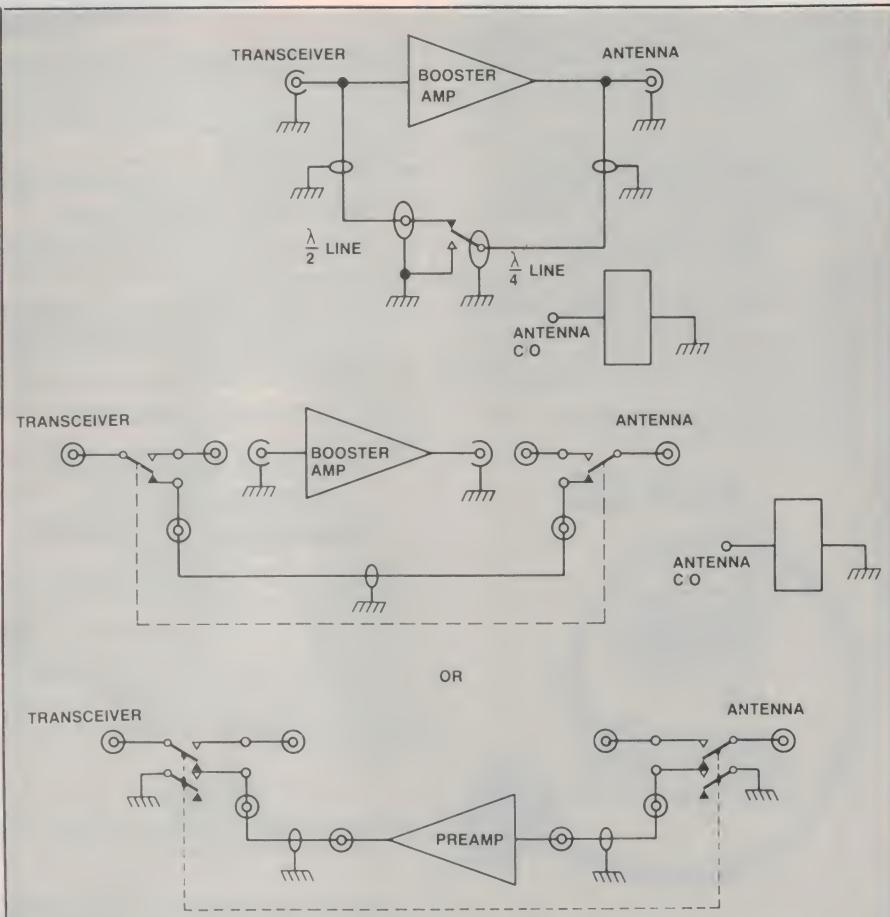
Test results and conclusions

After the original model was built and checked at dc it was tested at over the range 435 MHz to 475 MHz. All the original testing was at 470 MHz which is where the transistors are specified. After the routine amount of trouble with instabilities, everything worked fine and serious testing began. At the higher frequencies I was never able to get the full 4 dB gain given by the manufacturer and had to settle for a bit over 3.5 dB or about 22.5 watts for a fixed 10 watts in with no reflected power. However, at 438 MHz the gain was up to 4.1 dB to give nearly 26 watts out for ten in. The slightly off performance at 470 MHz was attributed to dielectric losses on the board and probably the trimmers were contributing too. It's rather hard to tell as when the amplifiers running everything gets a bit hot.

As far as amplifier bandwidth is concerned I was able to achieve 10 MHz virtually flat, and 36 MHz at the -1 dB output level.

Because of the quarterwave bias stubs, the second harmonic rejection was excellent at about -60 dB, but the third was not so good at -26 dB. Perhaps a filter may be needed if the antenna rejection is not enough.

Finally, the amplifier seemed to pretty well meet all requirements. The best one of all is the price; if you shop around a bit you should get all the bits for about \$1/watt! ●



Changeover switching schemes. Suggestions for adding antenna changeover switching using coaxial changeover relays. The top scheme requires accurate cutting of the lines.

5000 POWER AMPLIFIER

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REF: ETI JAN/MARCH 1981



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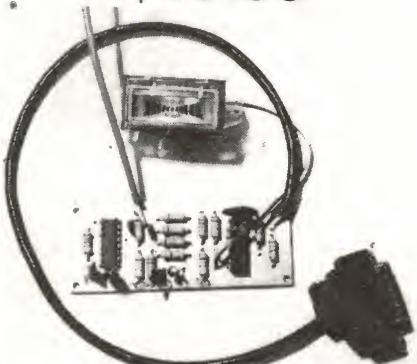
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1/3 Octave Equalisers have been used by professional engineers in Recording Studios and live concerts for over a decade now. It is no accident that the advent of 1/3 octave equaliser and studio quality live sound recording have gone hand in hand.

BUT FOR YOU THERE'S A CATCH!!

For Hi Fi stereo one of these units is not enough. They are mono so you will need one for each channel. Quite a lot of money really, but worth it if you want the best. Remember that whilst this unit is designed to operate in the 5000 system it will work with other Hi Fi equipment, line level in, line level out.

The Jaycar kit includes a fully pre-punched plated chassis, pre-punched heavy gauge front panel silk-screened to match the other 500 components. It is absolutely original but includes such refinements as quality IC sockets, UNIBRAKO socket head fixing screws, and brushless-look toggle switches.

You can purchase the kits one at time at \$199 each or, two, \$389 - a \$10 saving.

If you are one of the hundreds of happy 5000 users we are convinced that you will be just delighted with this unit.

Cat. KE-4204

SPECIFICATIONS

SIGNAL TO NOISE
FREQUENCY RESPONSE
BOOST/CUT
DISTORTION

~102dB with respect to 1 Volt
12Hz - 105kHz to -1dB
14dB (2dB total)
100Hz - 0.007%
1kHz - 0.007%
10kHz - 0.008%

CURRENT
CONSUMPTION(DC)

(essentially irrespective of cut or boost)
Approx. 100mA @ $\pm 15V$
(requires 30V AC CT)
Output short-circuit proof

FEATURING THE FANTASTIC
5534 IC AND STATE-OF-THE-ART
J-FET OP AMPS

ONLY \$199

ETI 674 MICROBEE PROPORTIONAL ANALOGUE JOYSTICK

REF: ETI DECEMBER 1983

Most computers offer joysticks as options but most aren't as sophisticated as this one. Your average joystick or games controller, is nothing more than four switches. This means that you can only go "full on" or "full off" in any direction.

NOW consider the 674. Whilst this LOOKS the same as other joysticks, you can for example move the stick say, 24 degrees from 12 o'clock (or North). The dot or object will follow EXACTLY. If you move quickly, the dot moves quickly. If you move the stick slowly the dot just CREEPS along! You can even write your name with the dot! Once again, the project is designed specifically for the MicroBee which Jaycar supports as a computer dealer.

The kit comes complete with software listing, high quality self centering joystick and Jiffy case.

Cat. KE-4674

\$35

Beware of apparently cheaper kits that do not have self centering joysticks.

2. Deluxe kit. Includes all of the above PLUS 3 extra "Personality" plugs, case with front panel and mains transformer, fuse, 240V plug etc. Also included are two sockets with extra long pins so that they can mount flush with front panel as well as extra components for 2764 programming.

Cat. KE-4651

\$55



ETI 668 uBEE EPROM PROGRAMMER

REF: ETI FEBRUARY 1983

This simple, low cost unit just plugs into the MicroBee's I/O port and enables you to save programs in any of 5 different EPROMs (2716, 2732, 2532, 2732A & 2764), which can be used in your MicroBee or any other microprocessor based system. As your MicroBee I/O port is effected with a Z80 PIO chip, this programmer can be used with any other system employing the same I/O. Jaycar has two versions of this kit.

1. Lowest possible cost shortform. Includes 2 x "Personality" plugs, 28 pin IC socket (as well as sockets for other ICs) Cannon DB15 plug, wire etc.

Cat. KE-4650

REPLACEMENT CASSETTE PLAYER HEADS

OK, so you have had that high quality cassette deck for some time now. You were thinking of updating to one of those fancy 3-head microprocessor decks but - well they ARE expensive!

Why not give your current deck a new lease of life?

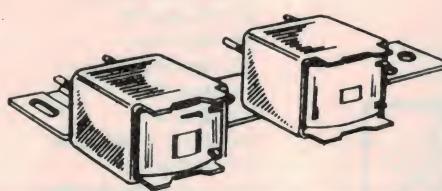
If your deck is more than 3 years old and has had a bit of work it's quite possible that the record/play head is worn. This can lead to poor HF performance. Or it may have never been any good in the first place. Or you may want

better performance than the head in your car cassette player can give. Jaycar now stocks replacement, very high quality cassette deck heads to suit most machines - especially Japanese. They are made in the U.K. by MONOLITH.

Amazingly most cassette deck heads are standard fittings (EIAJ). So even if you want to just refurbish that cheap player that you use to load programs into your computer Jaycar has the replacement head.

Cat. AC-1950 Mono record/playback	.....	\$14.95
Cat. AC-1952 Stereo record/playback	.....	\$17.95
Cat. AC-1954 Stereo record/playback for use with Dolby	.....	\$24.95
Cat. AC-1956 Stereo record/playback glass ferrite faced	.....	\$36.50
Cat. AC-1958 Mono or Stereo Erase	.....	\$7.95

(All record/playback have mounting hole centres on 17mm pitch and 12.5mm from face of head).



BISHOP GRAPHICS

You can now make "Professional Quality" PC Artworks and Boards in your own home. Of all the problems associated with Printed Wiring Board prototypes, preparation time and suitable apparatus stand out. With pre-coated laminate using the "DUPONT" product "RISTON" most of these difficulties are eliminated. "RISTON" is a negative acting dry film resist which is applied to machine cleaned laminates by means of a special precision hot roller applicator. The resulting "RISTON" coated laminate is then enclosed in a black polythene envelope, and is ready for use.

This means that the time involved in preparation of the copper surface, applying the resist, oven baking initially to dry the resist and post baking after development is therefore eliminated. Also important, is that the pre-coated "RISTON" is sensitive to 320 to 400nm ultra violet light sources thus special darkroom facilities are not required. Both the time involved and the facilities are needed for using pre-coated "RISTON" are minimal, but consistently high quality results can be expected with a very low reject rate due to breakdown during etching.

With each order for Bishop Graphics we supply free a booklet on how to do it, as well as handy hints on what not to do, what you'll need to finish the job etc.

PRE-SPACED PADS

HG-9906	0.100" diameter 1.58mm 240 pads	\$3.65
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HG-9908	0.156" diameter 2.54mm 150 pads	\$3.65



DIL PATTERNS

HG-9909	14 PIN	32 Symbols	\$3.65
HG-9910	16 PIN	32 Symbols	\$3.65
HG-9911	18 PIN	28 Symbols	\$3.65
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HG-9913	28 PIN	12 Symbols	\$3.65
HG-9914	40 PIN	8 Symbols	\$3.65



DIL PATTERNS - NARROW CUT

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HG-9919	16 PIN	32 Symbols	\$3.65
HG-9920	40 PIN	8 Symbols	\$3.65



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HG-9938	0.125" wide x 20 yards	\$2.95
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HG-9940	0.250" wide x 20 yards	\$3.95



DONUT PADS

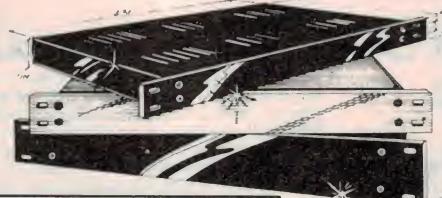
HG-9941	0.080" OD x 0.031" ID 96 symbols	\$2.95
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HB-5413	Natural	\$55.00	\$52.50	44
HB-5415	Natural	\$59.95	\$55.00	88
HB-5410	Black	\$45.00	\$42.50	88
HB-5412	Black	\$55.00	\$52.50	132
HB-5414	Black	\$59.95	\$55.00	132



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Cat. BB-7000

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VIDEO ENHANCER

REF: EA OCTOBER 1983
The Jaycar kit includes the box and Scotchcal label.

\$35



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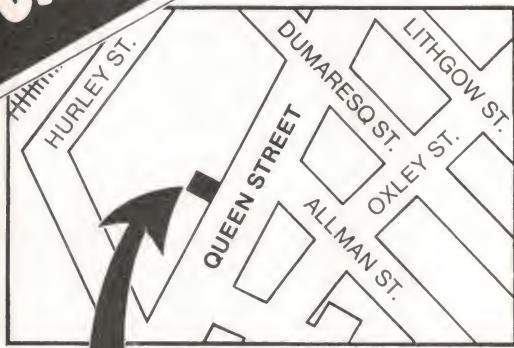
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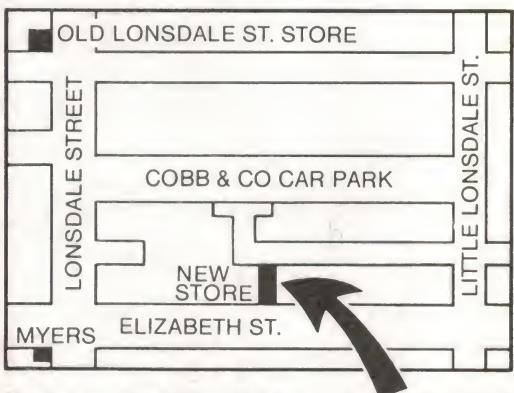
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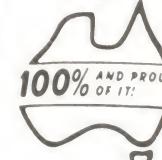
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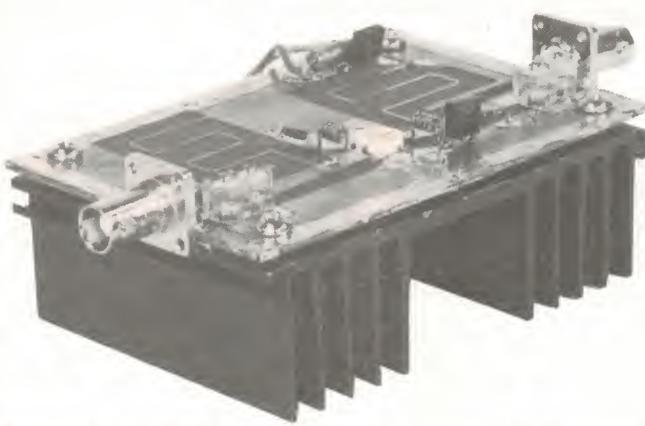
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7402	40	74LS32	40	74F152	1.58	74C2901	85	4520	1.00	LF13741	72	UA1488	70	Z80CPU	4.90	IN4004	05	BF470	80	ZN4033	70	4.7UF/25V	19	
7403	40	74LS32	40	74F157	1.58	74C902	80	4521	2.00	LF0002	10.90	UA1489	70	Z80ACPU	5.90	IN4007	05	BF494	27	ZN4036	49	10UF/160V	25	
7404	250	74LS32	40	74F158	1.58	74C904	77	4522	1.14	LF00042CH	9.50	UA2901	60	Z80CPU	11.00	IN5404	16	BF450	53	ZN4121	20	10UF/16V	19	
7406	250	74LS38	40	74F175	2.50	74C906	75	4526	1.90	LF0070-1H	15.90	UA3086	50	Z80P10	4.40	IN5408	18	BF490	72	ZN4236	1.30	10UF/25V	19	
7407	40	74LS40	40	74F181	4.35	74C907	75	4527	1.00	LF0071-1H	17.45	UA1436	1.20	Z80AP10	5.80	OA47	44	BU126	1.87	ZN4237	1.10	10UF/63V	20	
7408	40	74LS42	40	74F182	2.30	74C908	1.50	4528	82	LM10CH	6.50	UA170	4.60	Z80S10	12.00	OA49	18	BU208	1.50	ZN4250	19	2.2UF/25V	20	
7410	40	74LS47	54	74F189	6.80	74C910	12.50	4529	1.24	LM304H	2.95	UA180	4.60	Z80CPU	16.00	IN5402	22	BU3264	1.92	ZN4258	29	2.2UF/63V	20	
7411	40	74LS48	49	74F190	3.60	74C911	11.85	4531	1.05	LM10	3.00	ULN2003	1.25	Z80ACTO	5.90	IN5406	90	BU80X	2.50	ZN4355	19	4.7UF/16V	19	
7413	40	74LS49	150	74F191	3.60	74C912	12.50	4532	0.95	LM10	1.95	UD1393	65.00	Z80DMA	14.50	IN4009	36	BU3264	1.92	ZN4356	19	4.7UF/16V	19	
7414	80	74LS51	40	74F194	2.16	74C914	2.20	4534	6.00	LM311-14	1.80	UD1691	17.50	Z80ADMA	17.00	IN4010	20	BU262	30	ZN4360	50	10UF/63V	20	
7416	50	74LS54	40	74F241	3.15	74C915	1.55	4538	1.10	LM318	1.75	XR2204	5.95	7471A	36.00	BU102	70	BU102	3.95	ZN4402	18	10UF/63V	35	
7417	50	74LS55	40	74F242	3.15	74C918	1.80	4541	1.10	LM322	6.50	XR2205	5.00	7474B	26.00	IN3492	1.50	BU1001	2.50	ZN4403	18	2.2UF/16V	20	
7420	40	74LS57	40	74F251	1.75	74C920	5.50	4543	94	LM325	4.50	XR2210	6.00	7475A	74.00	IN3495	1.50	BU1002	61	ZN4407	61	10UF/63V	25	
7421	40	74LS57	44	74F253	1.75	74C922	5.60	4543	3.00	LM329	80	XR2216	2.80	7475A	30.00	IN3496	1.50	BU1003	61	ZN4408	61	10UF/63V	25	
7423	50	74LS57	44	74F257	1.75	74C923	5.40	4555	60	LM334	1.60	XR2240	3.00	VOLT REGS		IN3506	30	BU1004	8.00	ZN5089	20	10UF/63V	25	
7425	50	74LS57	44	74F257	1.75	74C925	7.50	4556	65	LM335Z	1.50	XR2243	2.00	LM309H	3.90	BRIDGES		IN4035	7.50	ZN5179	1.20	4.7UF/63V	19	
7426	40	74LS58	49	74F258	1.75	74C926	7.90	4558	1.40	LM336Z	1.80	XR2244	1.80	LM317H	7.50	MP1000V		IN4040	4.10	ZN5180	1.20	4.7UF/63V	19	
7427	50	74LS58	41	74F350	3.20	74C926	8.00	4560	2.50	LM349	1.85	XR2245	1.80	LM317V	7.50	MP1000V		IN4040	4.10	ZN5181	1.20	4.7UF/63V	19	
7430	40	74LS58	31	74F352	1.75	74C928	8.50	4569	2.10	LM350A	1.80	XR2246	1.80	LM317W	7.50	MP1000V		IN4040	4.10	ZN5182	1.20	4.7UF/63V	19	
7432	50	74LS59	60	74F353	1.75	74C928	8.50	4569	2.10	LM350A	1.80	XR2247	1.80	LM317X	7.50	MP1000V		IN4040	4.10	ZN5183	1.20	4.7UF/63V	19	
7437	50	74LS59	44	74F374	3.60	74C941	2.25	4584	7.00	LM377	2.10	IC90	12.50	BRIDGE		IN4045	1.80	BU1004	1.80	ZN5184	1.20	4.7UF/63V	19	
7438	50	74LS59	44	74F374	3.60	74C940	2.20	4583	7.00	LM380	2.10	IC90	12.50	MP1000V		IN4046	1.80	BU1005	1.80	ZN5185	1.20	4.7UF/63V	19	
7440	40	74LS59	44	74F374	3.60	74C940	2.20	4583	7.00	LM380	2.10	IC90	12.50	MP1000V		IN4046	1.80	BU1005	1.80	ZN5186	1.20	4.7UF/63V	19	
7444	89	74LS107	44	74F533	3.60	4000	4.599	4.20	LM380	1.40	LM381	1.80	MP1000V		IN4047	1.80	BU1006	1.80	ZN5187	1.20	4.7UF/63V	19		
7445	100	74LS109	38	74F534	3.60	4000	5.000	4.00	LM380	1.40	LM382	1.50	MP1000V		IN4048	1.80	BU1007	1.80	ZN5188	1.20	4.7UF/63V	19		
7446	100	74LS112	39	74S00	4001	50	9300	60	LM383	1.95	LM382	1.50	MP1000V		IN4049	1.80	BU1008	1.80	ZN5189	1.20	4.7UF/63V	19		
7447	80	74LS112	59	74S00	4002	50	9302	1.10	LM383	2.12	LM384	2.14	SH160	14.00	MP1000V		IN4050	1.80	BU1009	1.80	ZN5190	1.20	4.7UF/63V	19
7448	116	74LS123	61	74S02	47	4006	80	9304	62	LM385	2.14	SH160	14.00	MP1000V		IN4051	1.80	BU1010	1.80	ZN5191	1.20	4.7UF/63V	19	
7451	40	74LS125	40	74S03	45	4007	90	9307	1.50	LM386	2.05	SH160	14.00	MP1000V		IN4052	1.80	BU1011	1.80	ZN5192	1.20	4.7UF/63V	19	
7454	40	74LS126	53	74S04	40	4008	70	9308	1.90	LM386	2.05	SH160	14.00	MP1000V		IN4053	1.80	BU1012	1.80	ZN5193	1.20	4.7UF/63V	19	
7470	42	74LS132	45	74S05	44	4009	66	9309	1.90	LM386	2.05	SH160	14.00	MP1000V		IN4054	1.80	BU1013	1.80	ZN5194	1.20	4.7UF/63V	19	
7472	40	74LS136	40	74S08	44	4010	62	9310	80	LM387	2.05	SH160	14.00	MP1000V		IN4055	1.80	BU1014	1.80	ZN5195	1.20	4.7UF/63V	19	
7473	48	74LS138	90	74S10	44	4011	50	9311	1.69	LM389	90	SH160	14.00	MP1000V		IN4056	1.80	BU1015	1.80	ZN5196	1.20	4.7UF/63V	19	
7474	40	74LS139	90	74S11	44	4012	50	9312	1.69	LM390	90	SH160	14.00	MP1000V		IN4057	1.80	BU1016	1.80	ZN5197	1.20	4.7UF/63V	19	
7475	54	74LS151	47	74S11	45	4013	50	9313	1.69	LM391	90	SH160	14.00	MP1000V		IN4058	1.80	BU1017	1.80	ZN5198	1.20	4.7UF/63V	19	
7476	54	74LS151	55	74S11	45	4013	50	9313	1.69	LM391	90	SH160	14.00	MP1000V		IN4059	1.80	BU1018	1.80	ZN5199	1.20	4.7UF/63V	19	
7477	54	74LS153	55	74S11	45	4013	50	9313	1.69	LM391	90	SH160	14.00	MP1000V		IN4060	1.80	BU1019	1.80	ZN5200	1.20	4.7UF/63V	19	
7478	54	74LS153	55	74S11	45	4013	50	9313	1.69	LM391	90	SH160	14.00	MP1000V		IN4061	1.80	BU1020	1.80	ZN5201	1.20	4.7UF/63V	19	
7479	54	74LS157	40	74S14	78	4028	69	AD570	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD572	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7480	40	74LS157	45	74S14	78	4028	69	AD572	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD574	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7481	40	74LS157	45	74S14	78	4028	69	AD574	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD576	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7482	40	74LS157	45	74S14	78	4028	69	AD576	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD578	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7483	40	74LS157	45	74S14	78	4028	69	AD578	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD580	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7484	40	74LS157	45	74S14	78	4028	69	AD580	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD582	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7485	40	74LS157	45	74S14	78	4028	69	AD582	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD584	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7486	40	74LS157	45	74S14	78	4028	69	AD584	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD586	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7487	40	74LS157	45	74S14	78	4028	69	AD586	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		AD588	55.00	MC1406	9.00	SH160	14.00	LINEAR ETC.		
7488	40	74LS157	45	74S14	78	4028	69	AD588	55.00</td															



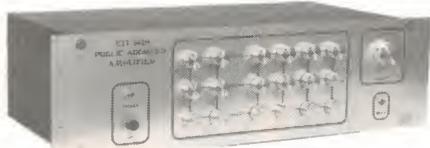
ETI-738 Booster amp

If you have problems with the SRF1078/2N6136, the original source in Australia is **Geoff Wood Electronics** in Sydney.

Chip capacitors are distributed by IRH, 53 Garema Cir-

cuit, Kingsgrove, NSW (02) 750-6444 and Uitramon Capacitors, 45 Railway Parade, Kogarah (02) 588-5844.

The trimmers are Philips types, stocked by the George Brown Group.



ETI-1420 Paging Amp

Parts will be readily accessible from most major retailers. If you have trouble with the OP597 try Auditec, 10 Waitara Ave, Waitara NSW 2077 in Sydney or Zephyr Products, 421 Warrigal Road, Moorabbin Vic 3189 in Melbourne.

ETI-1523 electronic scales.

Parts for the scales can be obtained from all the usual suppliers with attention to the following: the Bimbox 6007 case is stocked by **Jaycar** in Sydney. The CA3240E op-amps are available from **Rod Irving** in

Melbourne and **Geoff Wood** in Sydney.

The 74C935N/ADD3501 and the metalised poly capacitors will probably be held by **Geoff Wood**. **Semikron** in Sydney also has a range of the capacitors. The Neosid core is manufactured and distributed by **Neosid Pty Ltd**, 23 Pervical St, Lilyfield NSW 2040. (02) 660-4566.

Artwork

Unfortunately this month it has not been possible to include all the artwork for this month's projects in the magazine. They just won't fit! However, for those making their own pc boards or front panels from the ground up, same size positive or negative transparencies are available from our 'Artwork Sales'. Please address requests for this service to:

'ETI-xxx Artwork'
ETI Magazine
P.O. Box 227
Waterloo
NSW 2017.

When ordering, make sure you specify positive or negative, according to the requirements of your photoresist. Your cheque or money order should be made payable to 'ETI Artwork sales'. Prices for this month's projects are:

ETI-1523 . . . \$20
ETI-738 . . . \$3.40
ETI-1420 . . . \$20

This will buy all the artwork necessary for the projects, including front and rear panels and pc

board modules.

You might also care to know that almost every pc board (and most front panels) ever published by ETI may be obtained from:

All Electronic Components
118 Lonsdale St
Melbourne Vic 3000

and

RCS Radio
651 Forest Rd
Bexley NSW 2207

For pc boards produced in recent years, the following suppliers either keep stocks on hand or can supply to order:

Acetronics
112 Robertson Rd
Bass Hill NSW 2197
(02) 645-1241

Billco Electronics
Shop 2, 31 Pultney St
Dandenong Vic 2175

Jaetronics
58 Appian Drive
St Albans Vic 3021

Jaycar
117 York St
Sydney NSW 2000

Jemal Products
P.O. Box 168
Victoria Park WA 6100

Mini Tech
P.O. Box 9194
Auckland NZ

Rod Irving Electronics
425 High St
Northcote Vic 3070

4 x 1000W MUSICHASER



WRITE OR CALL FOR
FURTHER INFORMATION
ON OUR EXTENSIVE RANGE
OF SOUND AND LIGHTING EQUIPMENT

\$225.00

POST FREE
ANYWHERE IN
AUSTRALIA

- ★ SENSITIVITY CONTROL
- ★ ZERO VOLTAGE TRIGGERING
- ★ DRIVES NORMAL + INDUCTIVE LOADS
- ★ 3 CHASE MODES
- ★ 12 MONTHS WARRANTY



DISCO SOUND AND LIGHTING SPECIALISTS
63 HARDGRAVE ROAD, WEST END. 4101
POSTAL ADDRESS: P.O. BOX 377, WEST END. QLD. 4101
PHONE: (07) 44-4971

Hi-TECH LIGHT AND SOUND



PRE-STOCKTAKE SALE

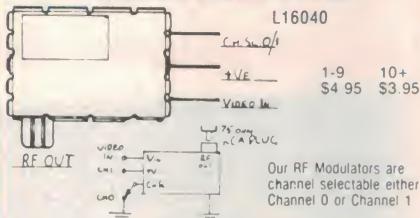
ENDS 15TH JULY 1984

PANEL MOUNTING RCA SOCKETS



	1-9	10+
P10232 2 way	35	30
P10234 4 way	45	40
P10236 6 way	60	50

VIDEO RF MODULATOR UNBELIEVABLE PRICE



DELUXE METAL CABINETS



A "STEEL" AT THESE PRICES

	1-9	10+
H10442 150x61x103mm	3.95	2.95
H10444 184x70x160mm	4.95	3.95

CANNON TYPE CONNECTORS DIRECT IMPORT PRICE



	1-9	10+
P10960 3 PIN LINE MALE	1.90	1.60
P10960 3 PIN CHASSIS MALE	1.90	1.60
P10964 3 PIN LINE FEMALE	2.50	2.10
P10966 3 PIN CHASSIS FEMALE	2.90	2.20

1/4 WATT 5% RESISTORS E24 VALVES CARBON FILM

\$1.00 per hundred
\$7.50 per thousand
That is 0.75 of a cent each
But Must Be The Same Value

34 WAY EDGE CONNECTORS FOR DISK DRIVES

SCOOP DIRECT IMPORT PURCHASE

	1-9	10+
IN5404	20	18
IN5408	25	20

Errors & omissions excepted.

HIGH CLASS INSTRUMENT KNOBS



Half price this month	H10060	35mm	50
	H10061	24mm	45
	H10062	20mm	40
	H10063	15mm	38

KEY SWITCHES



1-9	10+
\$3.95	\$3.75

MINIATURE PCB RELAYS



Massive 3A contacts at 24VDC or 100VAC Nominal 12V
Coil but will work OK from 9-15V

SPECIFICATIONS	S.P.D.T.	D.P.D.T.
S14060	S14061	
Nominal Coil Voltage	12V	12V
Contact Current (max)	3A	3A
Contact Voltage (max)	125VAC	60VAC
Coil Resistance	400 ohm	300 ohm

PRICE

1-9	\$1.20	\$1.50
10-24	\$1.00	\$1.20
25-99	\$0.80	\$1.00

ECONOMY TOGGLE SWITCHES



1-9	10+	
S11010 SPDT	1.00	70
S11020 DPDT	1.20	80

HORN SPEAKER



WOW \$6.95

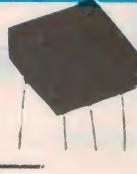
C12010

5" A B S Material Horn Speaker 8 ohm Freq Range 600-5000Hz Max Power 8 W

BRIDGES & DIODES

6A 400V Bridge \$1.50

1-9	10+	100+
IN5404	20	18
IN5408	25	20



DISCOUNTED PANEL METERS BUT BE QUICK FOR THESE



PANEL METERS NORMALLY THIS MONTH

PANEL METERS	NORMALLY	THIS MONTH
Q10500 MU45 0-1mA	9.75	6.95
Q10502 MU45 50-0-50uA	9.75	6.95
Q10504 MU45 0-100uA	9.75	6.95
Q10505 MU45 0-50uA	9.75	6.95
Q10518 MU45 0-1A	9.75	6.95
Q10510 MU45 0-5A	9.75	6.95
Q10515 MU45 0-10A	9.75	6.95
Q10520 MU45 0-20V	9.75	6.95
Q10525 MU45 0-30V	9.75	6.95
Q10535 MU45 VU	10.95	8.95
Q10530 MU52E 0-1mA	10.95	7.95
Q10533 MU52E 0-5A	10.95	7.95
Q10538 MU65 0-50uA	13.95	7.95
Q10540 MU65 0-1mA	13.95	7.95
Q10550 MU65 0-100uA	13.95	7.95
Q10560 MU65 0-20V	13.95	7.95

IC SOCKETS (LOW PROFILE) HOW CHEAP CAN THEY GO



1-9	10-99	100-999	1000+
8 Pin	15	14	9
14 Pin	16	15	10
16 Pin	17	16	11
18 Pin	18	17	13
20 Pin	29	28	26
24 Pin	35	32	28
40 Pin	45	35	30

5 WATT RESISTORS

WE ARE OVERSTOCKED
YOU REAP THE SAVINGS

1-9 10-99 100+ 1/2 PRICE

MORE PANEL METER BARGAINS



This Month \$2.95
Normally 4.50 4.50

Q10400 250 ua Sensitivity Panel cut-out 36mm x 16mm
Mounting hole centres at 49mm



This Month \$2.95
Normally 4.95 4.95

Q10405 250 ua Sensitivity centre. O. very useful for balanced circuit and applications needing a centre O. or null indication



2 1/4" Speaker
Only \$1.00



Welcome here

ROD IRVING ELECTRONICS

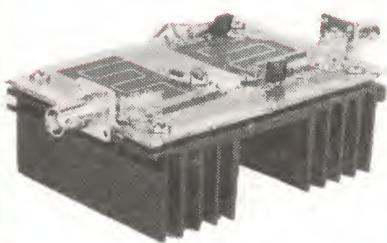
425 High St., Northcote, Vic. 48-50 A Beckett St., Melb., Vic.
Phone (03) 489 8866, (03) 489 8131. Mail Order Hotline (03) 481 1436
Mail orders to P.O. Box 235 Northcote 3070 Vic. Minimum P & P \$3.00.

Please address tax exempt, school, wholesale, and dealer
enquiries to: **RITRONICS WHOLESALE**
1st floor 425 High St. Northcote 3070 (03) 489 7099
(03) 481 1923 Telex AA 38897

NEW KITS FOR THIS MONTH

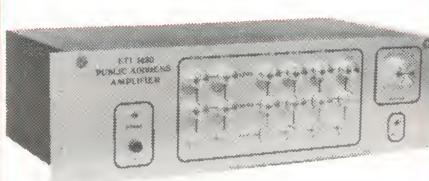
THIS MONTH'S KITS

ETI-738 25 WATT UHF BOOSTER AMP



Boost your UHF rig's output—you need all you can get! This low cost transmitter booster amp will give your signal quite a lift without breaking the bank. Great for FM or ATV rigs.

ETI-1420 PAGING AMP/SOUND SYSTEM



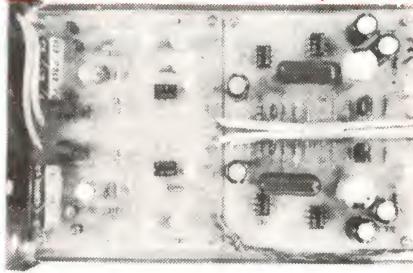
Just the thing for clubs, pubs, halls etc. Project features two low level inputs (one balanced, one unbalanced). Each input has level, bass and treble controls. The power amp employs the popular and reliable ETI-499 150 watt MOSFET module to drive a 100V line output.

AUDIO TEST UNIT FOR CASS DECKS \$47.50



EA October 81

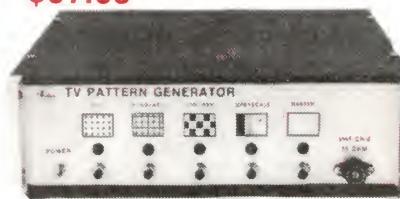
MIXER PREAMP TRANSFORMER \$26.50



Easy construction and versatile operation, this Preamp was for coupling with the 300W "Brute" Power Amp. **ETI 467** July 80

TV PATTERN GENERATOR

\$67.50



Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this completely new design which provides five separate patterns: dot, crosshatch, checkerboard, grey scale and white raster.

CAR BURGLAR ALARM \$70



EA MAY 84

CRYSTAL MARKER \$34.50 (INC 1MHZ X)

ETI 157 October 81



MUSICOLOR IV \$84.00



Add excitement to parties, card nights and discos with EAs new Musicolor IV light show. This is the latest in the famous line of Musicolors and it offers features such as four channel "Color Organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety. **EA August 81**

HEADPHONE AMPLIFIER

\$28



EA MARCH 84

TRANSISTOR ASSISTED IGNITION

EA November 79



\$34.50

VCR SOUND PROCESSOR

\$69.00



EA APRIL 84

Give the sound from your VCR a lift with this new VCR Sound Processor. Main features include an effective stereo simulator circuit, a 5-band graphic equaliser, and noise filtering.

ROD IRVING ELECTRONICS

425 High St., Northcote, Vic. 48-50 A'Beckett St., Melb., Vic.
Phone (03) 489 8866, (03) 489 8131, Mail Order Hotline (03) 481 1436

Mail orders to P.O. Box 235 Northcote 3070 Vic. Minimum P & P \$3.00.

Please address tax exempt, school, wholesale, and dealer

enquiries to: **RITRONICS WHOLESALE**

1st floor 425 High St. Northcote 3070 (03) 489 7099
(03) 481 1923 Telex AA 38897



Northcote store. Beautiful downtown High St, No. 425.

This occasional column introduces readers to those people on the other side of the counter in the electronics retail business — where you buy your equipment and component requirements. It serves to 'put a face' to the people who own and run the businesses you may deal with in the course of your job or pursuing your hobby, and to give some background on the business itself.

WHEN YOU STEP INSIDE Rod's Northcote store, you have to stand still, take a deep breath and look slowly around — just to take in the magnitude, multitude, breadth and variety of the electronics lines cascading down the walls, festooned from the shelves and glistening behind glass. It's a veritable Aladdin's cave! (Now there's a good name for a . . .).

Flipping through the 'phone book-like semiconductor data catalogues, one gets quite blasé about the huge variety described. However, when confronted by the 'wall of ICs' — the distinct characteristic of a Rod Irving store, you get a graphic picture that leaves you in no doubt about the breadth and variety of ICs and other semiconductors available.

"I don't think any other electronics retailer stocks the range and variety we do," says Rod, who's youthful, fresh-faced looks deceive you into thinking he's a choirboy, just popped in after practice at St Stephens down the road. It beats us how anybody could work so hard over the last seven years, building up such a sizeable business, and not get a few grey hairs and a furrowed brow.

Legend has it that Rod started his business in his garage (as all good electronics entrepreneurs do). Finding it a little cramped, he found himself a store in High

Rod Irving Electronics

425 High St, Northcote Vic 3070. (03)489-7099.



Heeeeere's Rod! With kits festooning the wall behind him.

St, Northcote, an inner-city suburb on the north side of Melbourne, a few blocks from his present store. As the fledgling micro-computer business began to blossom in the late 70s, Rod plunged right in and launched the "Big Board 1". This single-board, multi-featured computer kit enjoyed not a little success. The Big Board 2 superceded it about two years ago.

From the start, Rod Irving Electronics has specialised in kits and components. He carries pc boards and panels for pretty well every project published over the last five years or so. If it's not in stock, you can have it made for you, providing the artwork's available. Rod is a major supplier of the famous ETI 'Series 5000' hi-fi projects. In fact, he manufactures the power amp's heatsink front panel used on all kits now.

In December 1982, Rod opened a store at 48 A'Beckett St, at the 'top' end of the city (i.e. the end nearest the Carlton brewery). A'Beckett St in Melbourne is fast becoming akin to that famous short strip of York St in Sydney where there's a whole bunch of electronics retailers cheek-by-jowl. Under the banner of "C-Tech Pty Ltd", the store is run by Rod's partner, Greg Boot and specialises in computer gear, software and peripherals, as well as wholesale distribution.

A substantial proportion of Rod Irving's business comes from mail order. He'll ship just about anything, from a single resistor to a complete computer system.

It's easy to tell from Rod's advertisements or from walking into his stores that here is a business that stocks electronic parts in *breadth* and *depth*. Whether you're just after the run-of-the-mill things, like half-watt resistors, or the esoteric, like UHF power amp modules or a specialised

video controller chip, then you stand a good chance of finding it at Rod Irving's. The phenomenal range of project kits and pc boards stocked would take some beating (we've only ever found *one* competitor . . .) Take the tram from the city, right up the High Street, Northcote, and let Rod do it right for youuuuuu . . .! (as they say on the used-car ads on TV).



City store. In the heart of A'Beckett St.

FOR 30¢ POST AN ORDER TO ONE OF ALTRONICS COMPETITORS

— naturally you won't have a clue as to whether they've got the items you need available. And of course, be prepared to wait, wait, patiently wait sometimes for weeks! why waste your valuable cash? Altronics staff are waiting for your call now (up to 6pm eastern standard time).

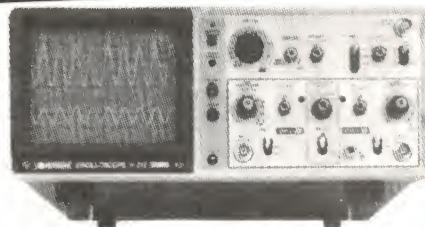
**NEW HITACHI F SERIES
SQUARE SCREEN DUAL BEAM CRO**

V-212 DC to 20 MHz, 1 mV/div, DUAL-TRACE

We are proud to include Hitachi's latest oscilloscope in our range of test equipment.

It features: • Thin, light and compact design (310W x 130H x 370D mm, 6 kg) • Large 6 inch rectangular, internal graticule CRT • Vertical

mode triggering selection to provide stable triggering of each channel • High accuracy $\pm 3\%$ • High sensitivity 1mV/div • Stable, low drift design • TV sync separation circuit built-in • Convenient X-Y mode for phase difference measurements • Tilting bail supplied.



FREE FREIGHT ANYWHERE IN AUSTRALIA

Q0152.....\$699.00

**MICROWAVE OVEN
LEAK DETECTOR**



ETI PROJECT

Completely passive project receives microwaves via an antenna which develops a voltage across a detector diode driving the meter. Monitor your microwave oven with this easy to build kit. All components mount on single PCB, including the meter. Genuine Hewlett Packard Hot Carrier Diode supplied.

K1724.....(still only) \$14.50

**THE DAZZLING
MUSICOLOR IV PROJECT**



Combination Colour Organ and Light Chaser. Four channel colour organ. Internal micro-phone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

K5800.....\$89.50

MULTIPROM INTERFACE

44K OF PROGRAM STORAGE



A sensational new kit for the MICROBEE, requires no modification to the computer except for the fitting of a 50 pin expansion socket. This project is easy to build and will allow you to store and software select up to 44K of eprom storage — acts like a mini disk drive system with the speed of RAM. Extra units may be added to further increase storage.

The Altronics Kit comes complete in every way

- ★ Full set of IC sockets.
- ★ Double sided, plated through board.
- ★ Assembled connection lead to Microbee.
- ★ Fully documented.
- ★ Cassette monitor included (plus sourcefile).

THE MICROBEE KIT OF 1983

K9673.....\$99.50

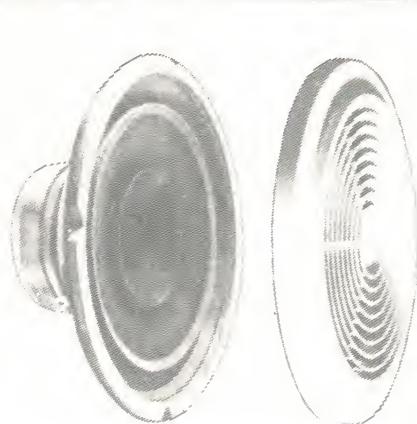
**8 INCH WIDE RANGE
DUAL CONE SPEAKER**

200mm (8 in.) 10 Watts Max. power input. Public Address, Background Music. Ideal HI FI extension speaker. Includes transformer holes at 51mm. Over 30,000 sold in Australia! Mounting holes 140 x 140mm.

C2000.....\$9.50 ea
10 Up.....\$8.70

**8 INCH
CEILING SPEAKER GRILL**

C0800.....\$2.75
10 Up.....\$2.00



**MINI SPEAKER
57mm**

200 MW 8 OHM
Large Ferrite Magnet.
Ideal replacement speaker.
Great for hobby projects.

C 0610...\$1.95
10 Up...\$1.50



**MINI SPEAKER
82.5mm (3 1/4 in.)**

3 watt 8 OHM
Mounting Holes at
71mm centres.

C 0612...\$4.75
10 Up...\$4.25



165 mm (6 1/2 in.)

Dual Z 4/8 OHM
3 Watt RMS
Mounting holes at
112mm.

C 0620...\$7.95
10 Up...\$7.25



**INCREDIBLE
VALUE
BULK
PACKS**

ALL COMPUTER
SELECTED

SUPER PRICE

\$5 each

R3501.....25W Resistor Pack
Av. contents 300.....\$12 Value

FUSE HOLDER M205

20 x 5mm Fuse

S5990.....90c
10 Up.....80c each



FUSE HOLDER 3AG

32 x 6.3mm Fuse

S6000.....95c
10 Up.....85c each





OR FOR 15¢ PHONE YOUR ORDER TOLL FREE ON 008-999-007

We will immediately confirm stock availability. We will also confirm the very hour your order will be dispatched (over 95% of orders leave the same day). **With Jet Service Delivery we deliver next day to capital cities and suburbs** — Country areas please add 24 to 48 hours. **Available bankcard holders only** — sorry non-bankcard holders must post a cheque or money order — even so, we promise to deliver quicker than any other supplier in Australia.

INSTRUMENT CASES

Our superb instrument cases will give your projects the professional appearance they deserve.

WAS	NOW	10+
H0480	\$13.50	\$11.50
H0482	\$17.50	\$15.00

10+
\$9.50
\$12.25

OEM'S — Manufacturers — Bulk Users. Your product will look like it's straight out of "Hewlett Packard's" factory with these brilliant low cost cases. Contact our Wholesale Department for Bulk Prices.

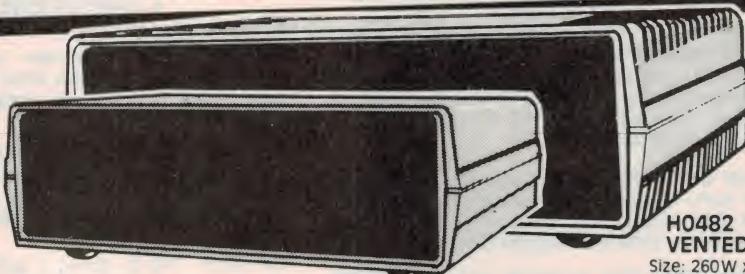
KEY OPERATED SWITCH

HALF PRICE! BE QUICK



S2500 \$3.50

H0480
Size: 200W x 160D x 70H



H0482 VENTED
Size: 260W x 190D x 80H

- Internal mounting posts enable a wide combination of PCB's, Transformers, etc. to be accommodated (screws supplied).
- Removable front and rear panels. Attractive textured finish one side and plain the reverse side. (Enables direct engraving, silk screen printing etc. to plain side.)

- Top and bottom split apart for ease of construction or service. Integral feet included.
- Great for test instrument and other high grade projects.
- PCB guide rails provided internally allow vertical PCB positioning to several locations.

LOGIC PROBE

01272
WAS \$29.50



- Directly powered from circuit under test (5V)
- Tested to 12 MHz
- DTL/TTL — CMOS Threshold selector
- Circuit loading 30UA approx.
- High-Low — pulse or memory led indication. Impulse

mode pulse length is extended to enable visual observation. In memory mode any detected level is continuously displayed until reset

ALTRONICS

105 STIRLING ST. PERTH — FOR INSTANT SERVICE

008 999 007
(09) 328 1599

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FOR SALE. HERO 1 educational robot. Complete with arm, speech synthesiser and all documentation. Cost over \$3000. Unwanted prize. Russell Martyn (08)382-5971.

WANTED. Discarded I.F. module from colour TV. Philips model K12A. J. Perdenia, 15 Bovey St, Cooper's Plains, Qld. 4108.

MEETING: Sydney FORTH group meets every second Friday of the month at the University of NSW, John Goodsell Building, (commerce) Room LG19 at 7pm.

COMMUNICATIONS

FOR SALE. TIME MARK GENERATOR and copy of radio and electronic laboratory handbook by Scroggie and Johnstone. David, P.O. Box 316, Manly NSW 2095. (02)938-3417.

WANTED: Correspondence with TV-DXers on setting up a receive station and TV-DX in general. Richard Jary, 18a Carlton Crescent, Kogarah Bay NSW 2217. (02)546-6905.

COMPUTERS

FOR SALE. S100 Computer system, DGZ80 CPU, ETI-640 VDU, ETI-681 PCG, 48K RAM, keyboard, power supply and monitor, only \$400 ono. A. Huish, (047)30-1805.

FOR SALE: ATARI 400. 32K RAM, BASIC plus assembler language. Datacassette, tapes, cartridges, books. All as new \$600. Peter Gray, 19 Wallace St, Kotara, Newcastle, NSW 2288. (049) 57-3354.

FOR SALE: TRS-80 Model 1 software. Over 40 games, write to Craig Sedgwick, 7 Eye St, Chifley, NSW 2036.

FOR SALE. MICROBEE software. Wimbledon Tennis. Tape and listing only \$5. Order now or send SAE for catalogue. T. Knowier, 9 Waterman Place, Fraser, ACT 2615.

FOR SALE: S100 boards, I/O two serial and nine parallel \$225. Z80 CPU board with serial port, \$299 (new price \$410). Manuals. (07)354-1349 after 6 pm.

FOR SALE. Shugart 8" drive new \$200, ETI 632 VDU and keyboard mounted in case \$100. SC/MP demo unit \$50. R. Adams, Reld's Way, Wooragee Vic 3747. (057)28-7217.

FOR SALE. VIC 20 (8K) Monitor, stand, data-cassette, many books, programs. Items retail in excess of \$1000. Urgent sale. Sell for \$450. Craig Wegg, 36 Baird St, Arrarat Vic 3377 (053)521-1472.

FOR SALE. 8 HM6116P-3 CMOS 2K RAM by eight bit chips. Excellent for 16K conversion for ZX 81 or Microbee. Cost \$90, will sell for \$55. Frank Papadopoulos, 13 Kroombit St, Dulwich Hill NSW 2203. (02)558-8636.

FOR SALE ZX SPECTRUM software. Space Raiders, Penetrator (48K), Haunted Hedges, Schizoids, Planet of Death. \$13 ono. Frank Papadopoulos, 13 Kroombit St, Dulwich Hill NSW 2203. (02)558-8636.

FOR SALE. APPLE program. Teach yourself mathematics. Send disk and \$5. Ian McGregor, 33 Cremin Street, Mt Gravatt, Brisbane NSW 4122. (07)343-2459.

FOR SALE. TI99/4A Home computer with extended basic, speech synthesiser and game cartridge. Retail value \$430. Will sell for \$350 ono. Phone Peter (076)93-7119.

FOR SALE. MICROBEE software: Mrs Pacman, excellent graphics and sound, three different mazes, floating fruits, \$14.99. Khanh Doan, 718 Beauford St, Mt Lawley WA 6050.

FOR SALE. TELETYPE model 15. 110 V 50 Hz, as used in ETI Oct. 83. Has RS232 interface, software for 6502 Superboard and 120 page manual. \$50 Knoxfield. (03)763-5983 a.h.

FOR SALE. SORCERER MK II 48k, sub-system disk drive, WORD PROCESSOR PAK, 24K Extended BASIC, lots of other software. \$1900 K. Meyer, 26 Station St, Schofields NSW 2762. (02)627-2510.

FOR SALE: DICK SMITH WIZZARD, 8 Cartridges plus BASIC, data cassette, book of programs. Sell \$500 ono. Michael Janoska (08) 258-4960.

FOR SALE: BURROUGHS B800 16-bit minicomputer, 128K memory, printer, circuit diagrams, spares. Urgent sale, bargain at \$400. Kevin, (063)33-5290 (free call) b.h.

FOR SALE. ZX 81 Memotech HRG. Near new. \$70. John (02)599-1180.

FOR SALE. VIC 20 program library. High quality games, utilities, educational and miscellaneous programs available. Send SAE to Chris Groenhout, 25 Kerferd St, Watson ACT 2602 for list.

FOR SALE: SORCERER Mk 2. 48K with Green Screen monitor, Exidy double density disk drives with software and all accessories. \$1300. H. W. Gilbert, 65 Wilks St, Calrns, Qld. 4870. (070) 54-5861.

FOR SALE. EXCALIBUR BASIC Monitor. Display formats include Hex, Decimal and ASCII. Cassette \$9.95 including postage. L. Adney, 5 Barling Ave, Seaforth, NSW 2092. (02) 949-1730.

FOR SALE: DGZ80, DG640, cassette interface, keyboard, bare S100 motherboard plus software dissem, edit assem, BASIC and three games tapes, all documentation, \$250. Paul (085)56-8340.

FOR SALE: ETI-660. 3K. Colour expansion. Excellent condition \$120 ono. TI59 programmable calculator, including manual, recharger, case \$75. Benjamin Begg, 18 Sturt Ave, Toorak Gardens, SA 5065. (08) 31-0310.

FOR SALE: NEC Advanced Personal Computer. Dual Disk monochrome includes word processor, Spreadsheet and BASIC disks plus extras. \$4000. Paul Cameron, 193 Chuculba Crescent, Giralang, ACT 2617. (062) 41-3926.

FOR SALE: CASIO PB-100 software: arcade and adventure games. Send SSAE for free catalogue to J. A. Scott, 904 Hamilton Rd, McDowall Qld. 4053.

FOR SALE. ACT VIC 20 bimonthly magazine. Many interesting articles and programs. June issue \$2.00. Bimonthly \$12 per year. Write to Chris Groenhout, 25 Kerferd St, Watson ACT 2602.

FOR SALE. MICROBEE Parallel "Centronics" printer cable, ready-to-go. No messy interface board, electronics contained in rear of Centronics plug, one metre cable \$36.00. David (02)47-9153 after 6pm.

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FOR SALE. SUPERMON for Atari. Stick-port printer-handler. Includes revision 'B' O.S. with extras such as CR. 13/13/14/15 and much more. For full information write now. RR for 400/800 \$89. For 600/800 XL \$99. Supermon, P.O. Box 507, Beenleigh, Qld. 4207. (07)209-7891.

WANTED: INFORMATION about the System 80. Software, anything else of interest. Contact R. Schatz, P.O. Box 17, Koorawatha, NSW 2807.

WANTED: ADDRESSES of suppliers of Commodore 64 software. Write to D. Hamilton, 32 Miro St, Young NSW 2594.

WANTED. TRSDOS for a model 1 level 2 TRS-80 with manuals. Paul Sprenger, 2nd Field Supply Battalion, Lavarack Barracks, Townsville Qld 4813. (077)71-7760.

WANTED MICROCOMPUTER evaluation kits, working or not (e.g. Motorola D2, D3, dream) any others, or peripheral devices considered. J. Facci, 14 Fashoda Street, Hyde Park SA 5061.

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D R E G S



Here at ETI, the recent SMPTE conference made us reflect on the history of television. In the beginning (as all proper pontifical palliatives begin) television was monochrome. Looking for a sales gimmick the Americans converted to NTSC colour (never twice the same colour). The French, running a good second, managed to generate the SECAM system (Something Essentially Contrary to the American Method). The British, last as usual, staggered home with the PAL system (peace at last!).

Speaking of which, I must remark that one of my pet hates is Jargon. You might have heard of 'high' technology (what Barry Jones is fond of), 'low' technology, (what Indians have when they're not launching satellites), and 'state of the art' (what Big

Ben will have when they put out an edible meat pie). But what, I want to know, is "recumbent technology". New Scientist magazine says that it is a term applied to the development of bicycles whose riders lie on their backs instead of sitting up on a saddle. I think it is a discovery made by the two gentlemen from the gas board who spent two days digging a three metre long trench outside my house.

And speaking of different types of technology, how about useless technology. The Japanese firm Sony has just introduced a TV set that produces a mirror image picture, i.e: on the flick of a switch it transposes the left hand side of the picture to the right, and vice-versa. Readers of ETI with nothing better to do during the next half

hour might like to figure out why anybody would want such a modification to their TVs. No prizes for the most creative solution!

Finally, there must be many young men out there who, at this point in their lives are wondering about the direction their careers should take. Our advice is don't go in for electronics, get into politics instead. We have just heard that the European parliament has decided that Europe needs a population increase. A report has called on members to examine the practical measures by which the birth rate can be increased. I'm sure that if ever the good members feel the task a little beyond them there must be readers of Dregs who will do all the examining necessary.

Ladies and gentlemen, be seated. (While you tune your receiver)

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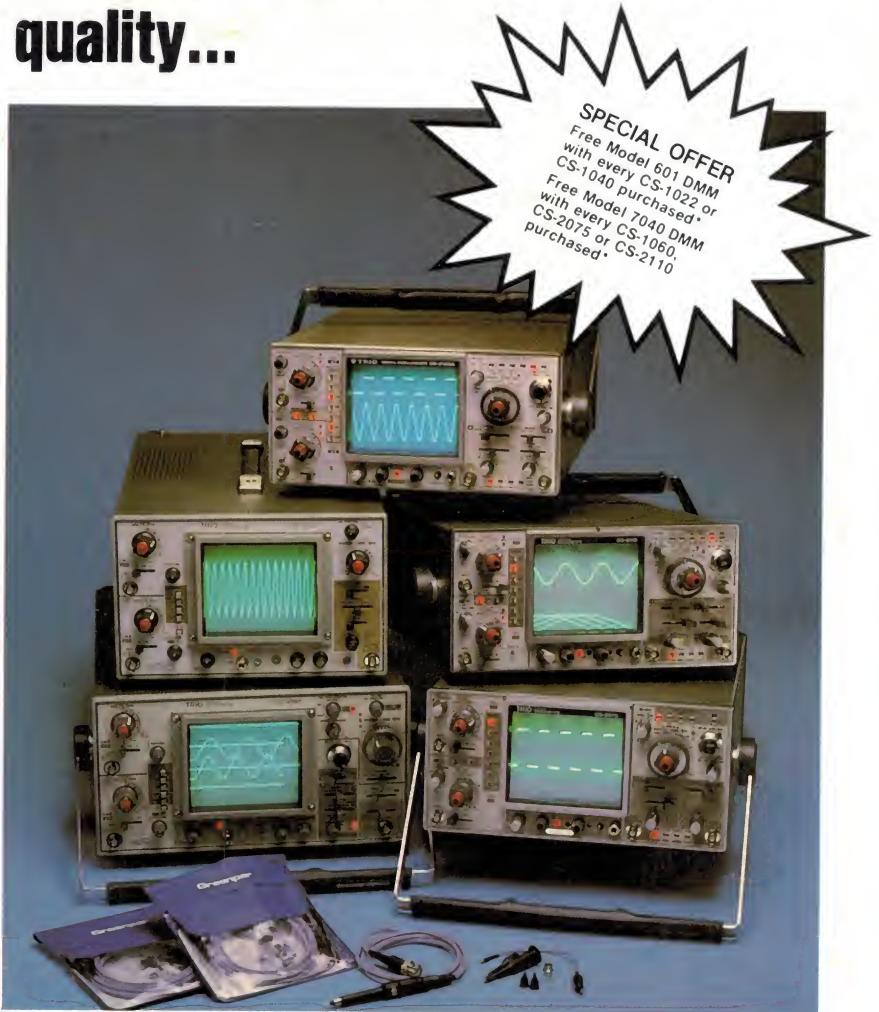
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